THE

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THE

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GAS AND ELECTRICITY.

OUR esteemed contemporary, the *Gas World*, being apparently anxious to convince its readers that electricity has no chance as a lighting agent in competition with gas, has published in a recent number an extract of the reports presented to the Brussels municipality on the gas and electric lighting undertakings of that city; and, to point the moral, concluded its article with the following paragraph:—

"M. Guégen, editor of the *Journal de l'Eclairage au Gaz*, commenting on the above, points out how poor the electric lighting result is. Here is a station working to its full capacity, and it can only make 3·64 per cent. to meet interest and sinking fund, while there is not a word about depreciation. The local conditions are all favourable, and yet this is all. The gas undertaking at the same time makes 8 2 per cent. on a capital of £720,000. The Geneva station has no dividend to declare, although it is worked entirely by water, and pays no tax to the municipality. The only way of making electricity pay seems to be by running small local stations."

We must confess to hoping better things for electricity than the doom foreshadowed by our contemporary, and propose to give one or two reasons for considering the comparison drawn by it between the two undertakings at Brussels as anything but conclusive. In the first place, it must be remarked that the gas supply has been worked by the town for 20 years, whereas the accounts of the electric light undertaking deal with its first year's working, and that whereas the total income for gas represents about 27 per per cent. of the capital expended, that for electricity is not quite 7 per cent. on the capital expenditure. Of course this argument is worth nothing, if it is true that the local conditions are all favourable, and the electric light station was working to its full capacity.

But what are the real facts of the case? We are enabled to throw some light on the subject, because a Town Councillor who shared the opinion of the gas journal as to the poorness of the result, made some serious charges against the efficiency of the plant, or of the staff responsible for its working, and demanded an inquiry by the three experts appointed to make the tests for final reception at the end of the contractors two years' working of the plant. The report of these experts has just been published in the *Bulletin Communal*, and we find that after a detailed examination, these gentlemen conclude that the comparatively poor return is due solely to the fact that, owing to the small number of clients, the station worked under very unfavourable conditions during 1894, and that the results for the first half of 1895 already show a marked improvement.

We note also that exception was taken to the manner in which the electric lighting accounts were drawn up, both by the experts and by a councillor, on the ground that whereas

the electric light station gets no credit for the current supplied for public lighting, a proceeding which diminishes the revenue about 20 per cent., on the other hand it is debited with various expenses incurred by the municipal electrical department which have nothing to do with electric lighting; the result being that the real earnings of the station are understated in the accounts.

As a proof that the Brussels Council is not dissatisfied with the working of its station, the selling price of electricity was by an unanimous vote further reduced, and stands now at 6·7d. per unit, subject to various discounts, for ordinary lighting, whilst a special price of 4·8d. per unit is to be charged for lamps in shop windows, whether fixed inside or outside the building.

We cannot help thinking that our contemporary has been somewhat unfortunate in the choice of the example it has taken to prove that electric lighting cannot pay; and we would suggest that a study of the accounts of some of our English stations would help to convince it that there is hope yet for electric lighting. For if we take the 8·2 per cent. gross profit of the Brussels gas works as a satisfactory yield, and note that no mention of depreciation is made in the gas accounts, any more than in those of the electric light station, we can point to about a dozen English stations whose gross profit before deducting interest, sinking fund, or depreciation, comes within measurable distance of this result.

MUNICIPAL ELECTRICITY!

Of all the amusing literature that comes before us, that particular section of it represented by papers read by municipal and county surveyors at their professional gatherings is the most markedly so. Prof. Ayrton has said that "there is an old idea that teaching is the refuge of the destitute who, not knowing how to do anything else, falls back on imparting his ignorance to others." The vein of humour in which this was cast, might well be adopted by those who criticise such papers as that recently submitted to the Association of Municipal and County Engineers by Mr. James Perry, and to which the title at the head of this article was given. As a popular exposition of elementary electrical facts it is lacking in accuracy, and we fail to see what benefit even a municipal surveyor would gain from its perusal. It appears that Mr. Perry is the engineer of the Galway Electric Company, a post he holds in addition to some others with which we have now nothing to do. He thought that his views and experience might have some interest for brother municipal officers, but unfortunately his views consist of some questionable deductions from a perverted Ohm's law, and his experience—or the results therefrom—are conspicuous by their absence. Mr. Perry follows the lead of Mr. Silcock, of King's Lynn, who some years ago endeavoured to persuade municipal engineers to act as their own electrical engineers. It is satisfactory to find, however, that a man like Mr. de Courcy Meade, of Manchester, does not think "that the average municipal engineer is likely to undertake any large installation of electric lighting without the assistance and advice of an expert electrical engineer;" while Mr. G. J. C. Broom, of St. Helens, is "of opinion that the municipal engineer should have the assistance of an electrical expert in carrying out an electrical installation"—an opinion which Mr. Broom put into practice when he had to light the St. Helens' Town Hall electrically, by calling in Mr. Bromley Holmes, of Liverpool, as his consulting electrical expert.

Mr. Perry believes that the City Surveyor should be an engineer in the widest sense, an opinion with which we entirely disagree, from an extended experience of the class. It is far more important that he should be a first-class business man, and know where to obtain the information he may require at any time, than that he himself should be a jack-of-all-trades, with the usual accompaniment of being a master of but few. Another fad of Mr. Perry's is to distinguish, with a needless nicety, between electricians and electrical engineers, and to emphasise his point he must needs offer a remark that is nothing less than a gratuitous insult to Mr. Ferranti, who was never a "mere electrician," —in bygone days we often wished he had been—and whose position to-day as a manufacturer is a sufficient answer to such a statement as the following: "A mere electrician is not an engineer, and when he undertakes an engineering job, necessarily makes a mess of it. There has been a good deal of messing. The scientific gentleman who is mainly responsible for the 'London Supply' is a man of undoubted ability, and as an electrician his reputation has scarcely suffered by the gigantic failure of that venture." This is what one is led into by following the argument Mr. Perry indulges in regarding the relationship of the astronomer and mariner, the dairymaid and the composition of butter, and the analogy between a moving rope and an electric current. The latter is offered to "engineers who desire to keep sane" in substitution for that knowledge of electrical facts which is expressed by the use of "block letters and German text letters and occult phrases and names of dead persons," "a language which no outsider understands." It is very evident Mr. Perry is a "plain man," and we can only wonder what he will do when he actually tackles alternating current distribution, as he professedly intends to do in the near future. In his opinion, "the wiring of houses is a kind of plumbing," and "the laying of mains involves digging and paving"; truly, and a great deal else besides, say we. One or two more instances of the Perry theory of electrical engineering must suffice. "This resistance," *i.e.*, the drop of potential in a cable, "might be called negative volts, but it is advisable to have a distinct unit for it, the '*ohm*.'" This is confusion of ideas with a vengeance, and is only equalled by the description of accumulators as "lead plates in cells filled with sulphuric acid." Amongst the wonderful things the writer of this paper has done are the running of arc lamps nightly from a shunt dynamo, and charging accumulators with both shunt and compound dynamos, the estimation of loss of energy in accumulators at 25 per cent., the arrival at the belief that 1½d. per unit is a reasonable rate for supply in large towns, and the putting forth the statement that public and private lighting should all be done from the same mains. Having concluded with the expression that "the subject is probably too large to be satisfactorily treated in a paper of this kind," Mr. Perry described a new form of tramway, which "may possibly set at rest for ever the vexed questions between overhead trollies and underground trollies," and we paused for breath on reading this, till we learned that it "was simply an extended alternating transformer spread out all along the track. An alternating current was sent

through a strip of copper, covered with thin sheets of iron, which were magnetised by the electricity thus actuating the motor. The success of this system would be entirely dependent upon the cost of working." So we should think! And the foregoing represents the conception of municipal electricity in the minds of some people!!

The Electric Lighting of a Great City.

Returning to the interview which the Mayor of Tunbridge Wells was pleased to grant to the representative of an esteemed contemporary, we note with satisfaction that Sir David, notwithstanding his prophetical leanings towards continuous current machinery, considers that the City Company, even with a system in which he does not quite believe, will soon head our contemporary's list in the matter of total cost per unit, but in this we think his view is over sanguine, for it probably does not take into account the detrimental effect of sudden variations in load which must always be provided for in boiler power. For instance, we remember a case last year when the load rose from about 150 kw. to 800 kw. in less than 10 minutes, and it must be obvious to anyone that a dark pall covering the whole city, such as we have seen in August, might call for the full power of the station. This possibility will, in our opinion, if it be constantly provided for, always seriously handicap the City Company in any attempt to break the record in cost of production. With the other remarks of Sir David on the construction of alternators, so far as we are able to understand his meaning, we heartily concur, with the exception of his reference to the "slight movements between copper and insulation caused by expansion and contraction, as well as the continual vibration due to the alternate current." In this matter we think Sir David has been misinformed, for, in fact, there are no such movements; if the copper expands the insulation moves with it. A man does not wear his shirt out by breathing, simply because his shirt is anchored to himself, and not to some external object; so the insulation on the copper, being wound on the copper, moves with the copper. In the second place, "the continual vibration due to alternate currents" is, like the phœnix, a mere creature of the imagination, for in a properly designed dynamo, whether it be called continuous or alternating, the direction of the current changes as the conductor passes from pole to pole, and the stress is consequently in one direction, although it varies in degree. Dynamos, continuous or alternating, can easily be designed so that the stresses are not only varied but also partially reversed; in such cases the vibration, which is, or may be set up, should be attributed to the designer and not to the alternating current, for it is obvious that if the current did not alternate in direction, then the conductors in passing from pole to pole of opposite sign would be subject to that very reversal of strain which Sir David attributes to the alternating current, but then under these circumstances the stresses would be opposite and equal; therefore, no power would be absorbed and no current would be generated; in fact, Sir David's ideal machine would not be a dynamo at all—but it might make a good coffee mill. It is to be hoped, for the sake of the City companies' shareholders, that their distinguished and gifted chairman, the prince of amateur electricians, is not employing the funds of the company in constructing an ideal dynamo in accordance with the principles whispered into the willing ear of our confiding contemporary.

The Portrush Tramway Fatality.

The fatal accident which occurred at Bushmills on the Giant's Causeway and Portrush Electric Tramway on 26th ult., is another addition to the lengthly list of mishaps which might have been prevented had proper precaution been exercised. The evidence given at the inquest went to show that the deceased cyclist and a companion had been riding many miles on the morning of the accident, and it having been raining heavily, they were wet to the skin. The electric tramroad is elevated about five inches above the ordinary roadway, a granite kerbing separating the two ways. It seems that the cyclist's machine struck the edge of this kerbing, and the shock pitched him on to the elevated rail which was charged at the time. His companion found him lying with his breast on the rail and the bicycle on the top of him. When taken off the rail he was found to be unconscious, and all attempts to resuscitate him were of no avail, death ensuing within about thirty minutes. The electric rail was stated by an engine driver to be 5 feet 6 inches from the kerb. The company's officials assert that the cyclist who so sadly met his death was at fault, and that no blame attaches to the company. They also contend that death was more directly the result of the fall from the machine and his being thrown upon the sharp edge of the conductor rail which smote him in a vital part, than from the shock which the deceased would receive from the current. The medical evidence, however, showed that while a throw of five feet against a hard substance might conduce to death, the visible injuries from that cause were not such as to cause it. There were two marks of burning on the breast, one over the pit of the stomach, and the other a little below it. There were also several smaller spots, all apparently caused by burns. Dr. Huey's opinion was that the death "resulted from shock, and the electric current may have caused it." Our own opinion is that the electric shock contributed more to the man's death than anything else, for although it was stated that tourists make a practice of taking shocks from the rails, we believe the voltage is quite high enough to cause death under certain conditions. Now that someone has been killed more stringent precautions will be taken; at all events the tramway should be separated from the roadway by something other than a mere five-inch kerb. The verdict of the jury was, as stated last week, that death was caused by deceased falling from his bicycle and coming into contact with the electric rail, there being a full current on at the time.

Niagara's Electric Plant.

A somewhat futile discussion has been going on between Prof. G. Forbes and others regarding the type of electric generators adopted at the Niagara works. The plant, as everybody knows, is hardly yet started, nevertheless engineers, manufacturers, and promoters connected with it are rushing into print and proclaiming the whole thing to be an unprecedented and prodigious success. It may be, and we sincerely hope that it will be, as great a success as these interested parties try to make it appear to be, but nothing in the designs or execution of the work, so far as we can gather at present, would lead us to assume that anything marvellously clever has been done to make this plant so very exceptional. In magnitude it is undoubtedly a great scheme, but the design of the generators and their construction are points about which a great deal of unnecessary boasting is going on; the low frequency of the alternating current employed is also held up for admiration. Now, whether this plant is to be a success or not can only be settled by lapse of time; the result of its continued operations and extension alone can definitely decide. The alternating current system in this case is possibly the best, but whether the machinery designed and erected for operating the system is any advance upon previous plants is a question which electrical engineers have not yet had time to finally give a verdict upon; judging, however, from American made alternating plants at the Chicago Exhibition we should scarcely expect the machinery to be superior to that of European manufacture. This is not the time for argument over the broad question of alternating *versus* continuous currents for Niagara. The former being adopted and now on its trial it is too late to discuss its adaptability and too soon to discuss its merits, hence we call the recent discussion futile. Some electrical engineers are still working away at high-pressure continuous current machinery, and in the end it may turn out that Lord Kelvin's preference for continuous current is founded upon the best of reasons. The increased pressures at which incandescence lamps can now be worked, and the improvements in generators and motor-generators steadily going on, has placed the relations between alternating and continuous current systems in quite a different light. The views held four or five years ago are greatly modified, and a continuous current system can at the present moment be considered applicable in cases where a few years ago it was out of the question.

ELECTRICAL FURNACES AND CHEMISTRY AT A HIGH TEMPERATURE.*

By H. MOISSAN.

The reverberatory electrical furnace with movable electrodes which we constructed in 1892, and which we have improved little by little since that time, is very simple; it has rendered us many services, and has enabled us to deal with questions that, before its time, could not be solved.

By means of this apparatus we have been able, by dint of a sufficient elevation of temperature, to realise the reproduction of the diamond, the crystallisation of the metallic oxides, the reduction of oxides before looked upon as irreducible, the fusion of refractory metals, the distillation of lime, silicium, zirconium and carbon, and, lastly, the abundant volatilisation of metals such as platinum, copper, gold, iron, manganese, aluminium, and uranium. Some of these substances, which could not even be brought to the melting point, such as magnesium, uranium, tungsten, molybdenum, can, with the reverberatory furnace, be brought to the gaseous state. We have often, during these researches, dealt with the vapour of lime or the vapour of silicium.

The starting of our apparatus is most simple. The current is conveyed by two flexible cables to the carbon electrodes, the diameter of which, of course, is increased with the current of the dynamos. Contact is established, the arc is formed, and by pushing back the electrode, more or less, we give to this powerful spark a constant length which depends on the electrical power and on the conductivity of the metallic vapours that fill the furnace.

At the beginning of the experiment, a penetrating odour of hydro-cyanic acid is produced; it arises from the combination of the nitrogen already in the furnace with the acetylene found at the commencement. It is a powerful reproduction of the synthesis of hydro-cyanic acid, obtained by M. Berthelot.

The purple flame of the cyanogen lights up the electric arc at first, then this colouring disappears, and the light becomes brilliant. The quicklime forming the interior of the furnace quickly melts and flows like wax, then boils. In a few minutes the electrodes are brought to red heat; clouds of vapour are sent out on all sides with ever increasing intensity. The lime is distilled in abundance, and covers the supports of the electrodes with a white coat. Thus, when we utilise current from machines of 100 to 300 H.P., we have in the midst of the furnace the excessively high temperature produced by the electric arc, at a few centimetres lower, the crucible containing the substance to be experimented upon, and at the bottom a layer of quicklime in full ebullition.

The bad conductivity of this lime is a fortunate circumstance for us; it insulates within the smallest possible cavity the maximum of heat that can be furnished by the electric arc.

This new apparatus, which we have modified according to the requirements of the experiment, has enabled us to undertake the study of a whole series of simple bodies which, up to the present, were only laboratory curiosities, for want of sufficient means to obtain them.

Chromium, the discovery of which we owe to Vauquelin, has already furnished us with several applications. Its oxides and other combinations have rapidly entered into industrial practice. If chromium has not furnished any alloys, if it has not been utilised as a metal, we must only blame the difficulty of its preparation. It has never been produced in any considerable quantity, and when its important qualities have been required for the manufacture of chromate steel, we have had to prepare in the furnace an alloy of iron and chromium, very rich in carbon, ferro-chromium.

It was easy for us, by means of the electric furnace, to obtain melted chromium in abundance, by reducing the sesqui-oxide by means of carbon. This casting, on being fined, gave us chromium, and this inoxidisable metal is very different from that obtained up to the present; it can be filed like iron, and will take a fine polish.

Chromium, which is more infusible than platinum, can therefore now be used for preparing alloys, without having recourse to ferro-chromium, which has the drawback of containing as much as 10 per cent. of carbon. In a single experiment, made in a reverberating furnace, we had at one casting to run off 20 kilogrammes of melted chromium. When the need of it is felt, this method will at once enter into industrial use.

This preparation of chromium will enable us to pursue effectively the study of the alloys of this metal. In combination with aluminium or copper, in fact, it gives interesting results. Pure copper alloyed with ·5 of chromium gains double the resistance, and this alloy is less affected by contact with damp air than copper itself.

Molybdenum, which had not until then been able to be melted, may also be obtained in considerable quantities. By heating in a continuous electric furnace a mixture of oxide of molybdenum and carbon, we prepare a casting of molybdenum that can be run out and moulded with facility. It furnishes a definite carburet, very perfectly crystallised; but, and this is an important reaction, it is fined by a second heating in the electrical furnace, in presence of an excess of oxide of molybdenum. The melted metal obtained under these conditions possesses a very fine grain and a bright surface. It can be filed, and when red-hot, wrought on the anvil. It furnishes a steel that can be annealed. These are quite new properties.

Tungsten is a body only known to chemists up to the present in the form of powder. Its preparation in the electric furnace becomes very simple. Under the action of the arc, the oxide of tungsten will be reduced by means of carbon, and will give us in a few minutes a well-melted sample of metal, covered with a beautiful layer of blue oxide of tungsten. This metal, which is more infusible than either chromium or molybdenum, can also be converted into a liquid with great facility. It does not seem, like the metals of which I have spoken, to have a great affinity for carbon, and tungsten, obtained without any very special precautions, is one of the purest bodies that we have prepared. With the spectrum analysis, the only impurities it shows are traces of carbon and calcium.

Metallic uranium had been produced in very small quantities by Peligot, with great difficulty, by reducing the oxide of uranium by means of an alkaline metal. Under these conditions the uranium was impure; it always contained sodium, and either platinum or silicium, according to the nature of the vessel in which the reaction was effected. At the ordinary temperatures of our furnaces, the different oxides of uranium are irreducible by coal. This is not the case at the high temperatures that can be obtained in the electrical furnace. By subjecting a mixture of sesqui-oxide of uranium and carbon to this calorific action, the reduction is effected in a few moments. After cooling, we take from the crucible a metallic ingot, bright where it is broken, and of great hardness.

When this uranium is slightly carburetted, it has the curious property of striking a light when brought into contact with a flint. The lighted particles burn with an energy and intensity far superior to that of a piece of iron.

All these simple metallic bodies melt at higher and higher temperatures. Beside them we will place other metals, the ores of which are somewhat rare, such as zirconium and vanadium.

This vanadium, which was the subject of some very fine researches of Sir Henry Roscoe's, was also only known under the form of a grey powder, containing, as impurities, hydrogen, oxygen, and a small quantity of alkaline metal. In my little laboratory at the *Ecole de Pharmacie*, Sir Henry Roscoe was able to see with surprise several hundred grammes of this rare body, in the form of cast metallic lumps, with a bright crystalline fracture. This simple body, the ore of which is of more extensive occurrence than is generally thought, had caused us some difficulty in bringing it to a liquid state; with a 40-H.P. engine, working an Edison dynamo, we could hardly succeed in melting some particles; the utility of very powerful currents was already making itself felt.

During these long researches, we had occasion, in conjunction with my assistant, M. Lebeau, to handle currents of very different strengths. We commenced with the very modest engine belonging to the Paris School of Pharmacy, a little engine of 4 H.P. As our requirements increased with the field of our researches, we accepted the hospitality offered us so kindly by Colonel Laussedat, and the Conservatoire des

* *La Nature.*

Arts et Métiers was good enough to place at our disposal an engine of 45 H.P. A little later, M. Meyer, the manager of the Edison Company, opened to us the doors of the splendid lighting station in the Avenue Trudaine, and we were enabled to make experiments with engines of from 100 to 300 H.P. The accompanying figure gives the general view of the dynamo room in which our electrical furnace was placed.

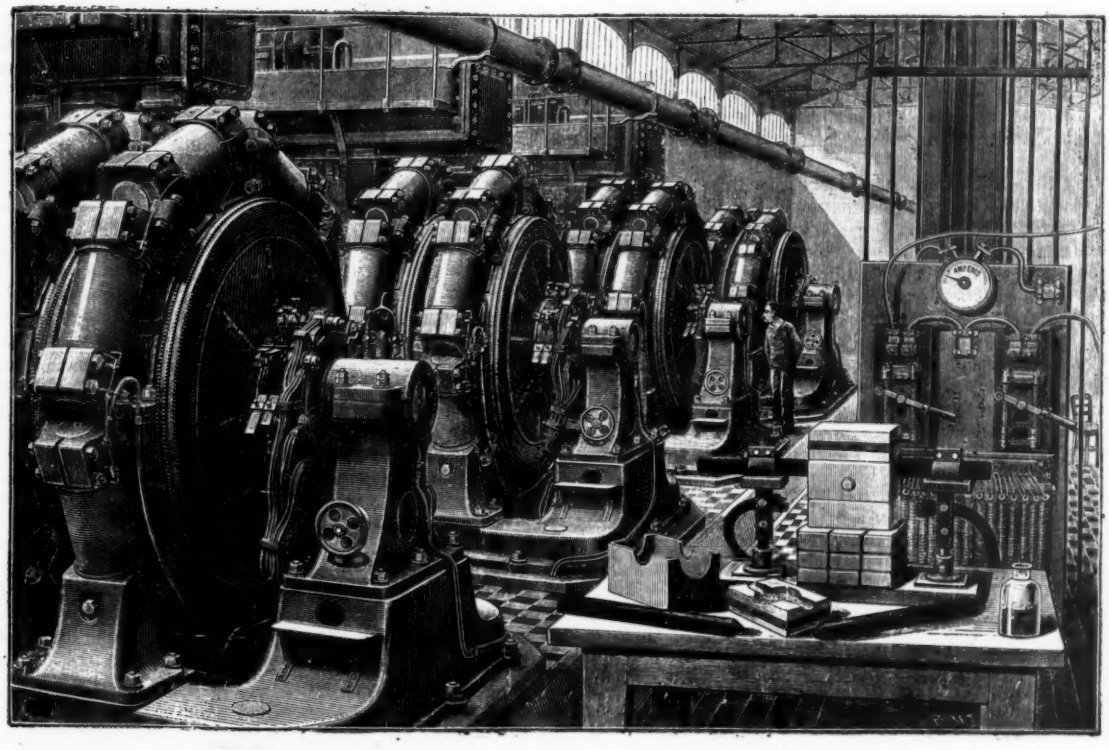
From all these experiments, we concluded that the calorific intensity of the electric arc certainly increases with the intensity of the current.

M. Rosetti regarded the electric arc as possessing a constant temperature, whatever might be the force that produced it, and he attributed to this arc the temperature, perhaps excessive, of 4,800°, and to the positive electrode, with a current produced by 120 Bunsen elements, a temperature of about 4,000°. Although the enormous disengagement of heat furnished by a powerful electric arc has not yet been measured by scientists with indisputable accuracy, it is very certain that great strides have been made in this direction, and that we are far beyond the 2,000° that we formerly arrived at in the laboratory.

In the researches that I have just described, the word carburet recurs at every moment. In fact, most simple substances form, in conjunction with carbon, combinations that are well defined, crystallised, and stable at high temperatures, and which add a new chapter to mineral chemistry. These combinations will subsequently play an important part in the classification of metals, and their properties are sometimes very singular. Some decompose water when cold by liberating acetylene, formene, or ethylene; the carburets of hydrogen obtained under these conditions present great purity.

As I remarked before, the preparation of refined metals, that is, metal free from coal, must be somewhat rapid. The liquid metal must be subjected to the action of the vapour of carbon, if we do not wish to obtain the carburet, which can itself be volatilised during the continuation of the calorification of the arc.

M. Daubrée estimates that the carbon of all our present organic compounds might have originally been combined with the metals in the form of metallic carburets. The electric furnace seems to realise the conditions of this remote geological period. It seems to us probable that these compounds may be existing in the stars at a high temperature. We may add that at this same period nitrogen might have been met with in the form of metallic nitrates, whilst probably hydrogen existed in large quantities in a free state in a complex gaseous medium.



View of the Dynamo Installation of the Compagnie Continentale Edison.

After the metals to which I have alluded, we studied a much more refractory body—titanium. By means of a 4-H.P. engine, a mixture of coal and titanic acid gas gave us protoxide of titanium; with a 45-H.P. engine, we could only obtain nitrate of titanium. Under the action of engines of from 100 to 300 H.P., we prepared, always in kilogrammes, a crystallised carburet, and then the true titanium, the properties of which are totally different from those previously attributed to the grey powders bearing this name. This body catches fire in the fluid state; it does not decompose water except at red heat, and it possesses the curious property of burning in nitrogen at a high temperature, producing the nitrate of titanium studied by Friedel and Guérin. It readily combines with carbon and silicium. It does not combine with argon, the new constituent of the atmosphere, as Prof. Ramsey found in my laboratory. The melting point of titanium is very high; in this respect it resembles carbon. It differs from this body, however, in that carbon, under ordinary pressure and at a very high temperature, passes, as we have shown, from the solid state to the gaseous without becoming liquid, whereas titanium can be liquefied and then volatilised in the electric furnace.

All these simple bodies which are obtained in the electrical furnace in kilogrammes, have also borides and silicides that are very well crystallised, and sufficiently hard for some to cut the diamond with facility. What part will they play in the manufacture of steel? Will they, like chromium, be able to impart hardness and new properties to iron? Time will show. However this may be, a new branch of chemistry at high temperatures is being formed, and industry will probably derive numerous applications from it. I am convinced that the treatment of metals by means of the heat of the electric arc will be developed further and further. We shall thus avoid adding to the ore all the impurities of coal; gangs and solvents will disappear, and the mixture in which the reaction is to be effected will at once be brought to the temperature required. These transformations will be quickly effected.

Shall we give an instance? We showed last year that it

was easy to obtain with the electrical furnace a crystallised carburet of calcium which had the curious property of decomposing cold water as energetically as sodium. But whereas sodium produces hydrogen, our carburet disengages acetylene gas, the properties of which have been described in a masterly manner by M. Berthelot. This acetylene, so rich in carbon, possesses an illuminating power far above that of ordinary gas. We will add that three kilogrammes of carburet of calcium will give a cubic metre of acetylene gas.

In America, England and Germany, the chemical works are making preparations for the industrial production of this generating carburet of calcium. It is hoped that this gas will be able to be used either in combination with ordinary gas, or as a substitute for it, in certain special applications.

This important modification that is about to be introduced into certain industries, thanks to the employment of electrical forces, is being universally recognised. We draw from the forces of nature all that they can give, and their transformation into electricity enables them to be utilised with facility.

CARBON BRUSHES FOR HEAVY CURRENTS.

By G. E. HARTMANS, M.I.E.E.

To those engineers who have the misfortune to be in charge of machines whose most brilliant feature lies at the toes of the brushes, the following experiments may present some interest.

Having first introduced one of the machines referred to as a 10-pole shunt with drum armature designed to give 500 ampères and 230 volts at 120 revolutions, with a commutator of diameter 3 feet and width 7 inches, I will proceed to enumerate the various combinations of copper and carbon which we used as brushes and the results in each case.

(1). Our first excursion was made with three pairs of ordinary copper stencil brushes filed to a bevel of rather more than one section, *i.e.*, ½-inch, and it was soon apparent that something cheaper than commutator sections must be forthcoming to satisfy the sparky appetite.

Fig. 1.

Fig. 2.

(2). We then decided to try the effect of a carbon tip dovetailed into a copper carrier (fig. 1) placed in front of and touching the toe of each brush as shown, the total width of copper

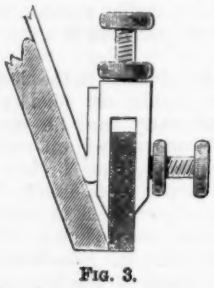


Fig. 3.

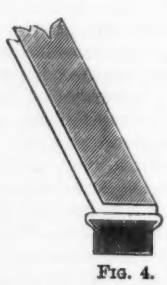


Fig. 4.

and carbon forming the bevel remaining the same as before. This was a decided improvement, but only for a short time, as the wear of the copper brush and flexibility of the arrangement caused a gap (fig. 2) between the copper and carbon, and the sparks returned to their former diet—to wit, the commutator. In addition the carbon tips got hot and their contact with the copper carrier deteriorated.

(3). We were then at some trouble to design a suitable holder for each carbon insuring their nice adjustment and good contact, and arrived at the ornamental result shown by fig. 3. One or two runs with these brushes gave us some encouragement, but we were deceived in thinking our troubles were ended, for first one flat and then half-a-dozen made their appearance, and the weight of the carbon and holder, which was necessarily rather rigid, jolting over the sore places was too much for even a copper skin. So we were obliged to return to No. (2), whilst the commutators were refreshed with an emery bob.

(4.) The next bait for the sparks was a set of carbons served up as shown by fig. 4, carefully bedded and mounted in clean copper clips, the brush being placed on the top for the necessary rigidity and copper section. The total section of carbon being 3 square inches, the width slightly exceeding one section. Here, as before, the first few runs were most reassuring, the comparatively small section of carbon carrying 450 ampères in a manner far exceeding our expectations, due, no doubt, to the cooling action in passing over such a large commutator

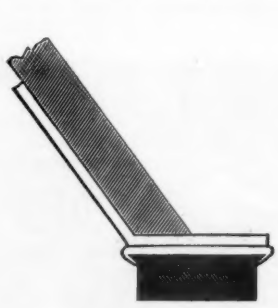


Fig. 5.

surface. The sparking was practically nil, and the face of the commutator absolutely unmarked. On running with the full load 500—550, the carbons required careful watching and frequent applications of vaseline, as they showed a tendency to become red hot, not all over, but suddenly in patches, and the contact between the copper and carbon became impaired as before through the continual heating. We therefore confined ourselves to a load of 450—480, using a small unit to relieve the larger ones.

(5). The same arrangement, but with double the width of carbon (fig. 5) was also tried, the result being that our position was rather safer at 500 than with the narrow carbons, and with these brushes we continued to run for more than a month, renewing the carbons occasionally as they became too much wasted. The commutators remained in perfect condition.

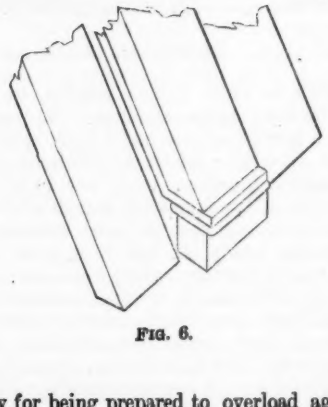


Fig. 6.

The necessity for being prepared to overload again directed our attention to the brushes, and another effort was made in the way of a compromise (fig. 6) between all copper and all carbon.

(6). Two pairs of copper brushes as in (1) and one pair of carbon brushes as in (4), the latter set rather less than a section in front of the former, are now in use.

This arrangement gives far better results at loads of 500—560 than any of the previous trials. No marking of the commutator taking place under the carbons, whilst it is

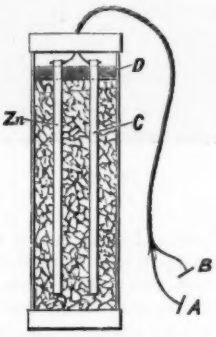
hardly perceptible under the copper brushes after nearly a month's running. It was found that the tension on the carbons should exceed that on the copper brushes sufficiently to enable them to take their full share of the current as nearly as possible.

I understand the last arrangement is no novelty on the continent, being in use at Hamburg, and other central stations. My chief assistant, Mr. T. W. Bloxam, suggested this arrangement to me, and after giving it a trial we are able to consider our efforts quite successful.

THE THERMO-OZONE BATTERY.*

We have in the past received numerous letters from earnest parties enquiring as to the merits of Dr. Beckwith's so-called thermo-ozone battery, to all of which we have replied by letter exposing its pretensions in no uncertain terms. The time has come, however, when it seems advisable to publicly expose its fraudulent nature, first, by reason of our further inability through lack of time and desire to reply to such letters, and, second, because the device comes before the public with the endorsement of several gentlemen known to the electrical profession, who probably through ignorance have allowed their names to be used. These gentlemen are Messrs. W. T. Eckert, T. T. Eckert, jun., Francis Broadnax and E. G. Cargill. Three of them are personally known to us, and it is with deepest regret that we see their names used as endorsers of a fraud as unmitigated as that of the electropoise, actina, or the electric belt. We would gladly spare these gentlemen the pain of a well-merited rebuke but there is a duty which we owe to the public as well as to ourselves which compels us to take the stand we now do.

In a little pamphlet issued by Dr. Beckwith it is stated that one of the editors of this paper "visited us February 28th, 1895, and stated that he desired to make a full examination of our invention, and was ready to expose and publish any wrongful claims that were made respecting it." So far the statement is absolutely true, but it goes on: "The examination lasted nearly three hours, when he stated that the invention was scientifically constructed and capable of generating a thermal current of electricity. He procured a battery for Mrs. ——— and requested us to take charge of her case."



This is absolutely false. We made no examination of the battery at the time further than to take it apart so as to see the inside arrangement and to listen to the theories of its promoter. We did procure a battery—not for use of the party mentioned, nor was she placed in Dr. Beckwith's charge. Our procuring of the battery was for the purpose of testing it electrically.

The pamphlet goes on to say: "His opinion and conclusion are of more intrinsic value than volumes of sentimental testimony."

This being the case it gives us unusual pleasure in expressing our opinion of the battery and the claims of its promoter.

The accompanying cut is a sectional view of the so-called thermo-ozone battery, which may be described as follows:—

It consists of a brass tube, 1¼ inches outside diameter, and 5 inches long, hermetically sealed at either end with gutta-percha plugs over which are screwed brass caps.

Inside of the tube are placed two slender rods ¼-inch in diameter—one of copper and the other of zinc—marked in the sketch C and Zn. Around these is tightly packed a dry powder. These rods extend at their upper end through the gutta-percha plug, D, and to them are attached flexible cords terminating in the electrodes, A and B, by which the battery is applied to the person.

The construction of the battery is such that it is entirely watertight, and the method of using it is to place the cylinder in a vessel of cold water (*à la* electropoise), and apply the electrodes. Now one of the claims is that a thermo-current of electricity is thus generated, and another is that there is also a galvanic current. As a matter of fact, the construction is such that a thermo-current would be impossible under any conditions, and a galvanic current equally impossible so long as the powder remained dry. Careful tests have shown the total absence of electrical currents under the conditions of use. If water is admitted to the cylinder a very slight current will flow for a very short time, but the battery polarises so rapidly that this soon practically ceases.

Another claim is that by means of this battery drugs may be administered through the skin by what is termed electrical osmosis or *cataphoresis*. Drugs can be so adminstered under certain conditions by the assistance of the electric current, but it would be impossible to so administer it by this device, even supposing that it gave a current, for it would require something over 60 of the cells joined in series to produce any effect, because of its extremely low electromotive force. The battery gives no current, however, unless it leaks, and the one we examined did not leak at all.

Another claim is that it introduces ozone into the circulation. In the first place, gases cannot be administered by cataphoresis, and in the second place this battery could not under any circumstances whatever produce the slightest trace of ozone. Very high potentials are required for this, and even if these were at hand, the method of applying the electrodes to the body are such as to practically preclude its formation. There is still another point. Supposing that the ozone were generated and introduced into the system by cataphoresis, the results would certainly be disastrous—perhaps fatal.

In the popular mind, ozone is health-giving, revivifying and beneficial in every way. This is a misconception. It is most violent in its action, and even when inhaled in small quantities produce alarming symptoms. To introduce it into the blood would be suicidal.

To conclude, then, the battery itself has nothing scientific about it, but is a bungling and cheap attempt to deceive, and in the second place the theory which Dr. Beckwith advances, and by which he hopes to mislead the public as to its curative properties, is as bungling and unscientific as the battery itself.

* New York *Electricity*.

RADIUS OF A BRAKE STRAP.

In our last issue we published a second letter from our correspondent, Mr. Herbert, which arrived too late for comment. In this second letter Mr. Herbert acknowledges that his first letter, described as correct and unanswerable by our yellow contemporary, which stated that "Mr. E. G. Herbert politely points out an error in an article on rope-break (!) engine testing; to his letter there is no reply—given or possible," was quite wrong, and that we were right, but in clambering out of the slough into which our contemporary so madly plunged after him, Mr. Herbert appears extremely anxious to haul us also through the mire and we decline the honour. It may be remembered that Mr. Herbert supposed a perfectly flexible brake strap of material thickness and we declined his assumption as altogether contrary to mechanical sense, as we could only conceive of a perfectly flexible strap being infinitely thin, and in this light alone could we allow Mr. Herbert's claim that the weight would hang immediately below the rim of the wheel. We passed by his ideal strap without further comment, and now, forsooth, because our idea of flexibility does not coincide with his crude impossibility, Mr. Herbert wishes us to pose in the same white sheet of penance as himself, and has been so very anxious about it that though he knew of his error as

soon as he had posted letter No. 1., he has been a month in acknowledging that the French practice, to which we did but draw attention as correct, was right, as French practice in niceties of mechanical work very usually is. Our contemporary, who so hotly flung itself in the breach on Mr. Herbert's behalf, has been good enough to pity what it terms our inartistic performance. Clearly its creed places flippancy first and correctness a far second, if even that. We do not think Mr. Herbert mends his case by his laboured attempt to explain the truth of our original position by excusing his error on the ground that he would be right if friction were abolished and sundry other impossibilities were created.

We really think he would be better occupied endeavouring to help our contemporary out of the slough from which he so tardily and unwillingly climbs himself. His second letter evidences an entire misunderstanding of the whole scope and meaning of the question, and an inability to grasp the object of the experiment we recommended, which certainly was not an experiment from which the particular form of friction in question was eliminated. We fear Mr. Herbert is as hasty in his reading as in his writing. Now is the time for the cold scientific criticism which our contemporary hinted it might have let out, but didn't!

AN EXPERIMENT IN WATER WHEEL GOVERNING.

Writing in the New York *Electrical World* Mr. Wm. W. Handy says:—It is well known among engineers that water wheels constitute the most difficult class of prime movers to govern, and also that prime movers require very close regulation when running dynamos.

Now just at this time, when water power is being so largely used for electrical transmission, the need of good governing is more felt than ever before.

In an experiment carried out by the author on a turbine plant supplying current for incandescent lighting, very good regulation was obtained by means of a simple electric governor.

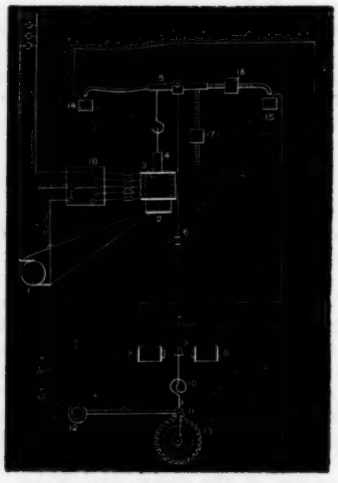


Fig. 1.

The diagram, fig. 1, shows the principle on which the governor works. Connected to the dynamo, 1, is a shunt coil, 2, and a series coil, 3. These coils are connected to the dynamo in such a way that the action of one opposes that of the other. The coils attract a plunger, 4, which is suspended from a lever, 5; 14 and 15 are mercury cups, into which the ends of the lever may dip. These cups are connected, as shown, to the magnets 7 and 8; 6 is a storage battery connected, as shown, to the lever and the magnets. It is readily seen if the lever, 5, moves from a central position it closes the circuit through one of the mercury cups and causes one of the magnets, 7 or 8, to become excited.

These magnets act on an armature, 1, which is connected by the spring, 10, to the double pawl, 11. The pawl obtains constant reciprocating motion from the eccentric, 12, which in turn obtains constant motion from the water wheel. As the armature is attracted by one or other of the magnets the pawl is caused to engage with the ratchet wheel, 13, and turn it in a direction depending on which magnet attracts the armature. The ratchet wheel is connected to the gate shaft of the water wheel, and as the ratchet wheel turns the gates are opened or closed, thus governing the speed of the water wheel. When neither of the magnets are excited, and therefore the armature not attracted by either, the pawl is held in a central position by means of a spring, not shown in the diagram, and the ratchet wheel, and therefore the gates remain still.

Now suppose the dynamo is running at the right voltage with no load on, and consequently with a current through the shunt coil, 2, only, the weights 16 and 17 being adjusted on the lever so as to balance the pull of coil, 2, just sufficient to keep the lever in a central position. Now when the full load is thrown on the dynamo, it is desirable in constant potential distribution to keep the voltage constant at the end of the line, and this is attained by this governor in the following manner:—Due to the increase of load, and the consequent decrease of speed and voltage, the current through the series coil, 3, will increase and through the shunt coil, 2, decrease. The pull on the plunger will decrease, and the lever

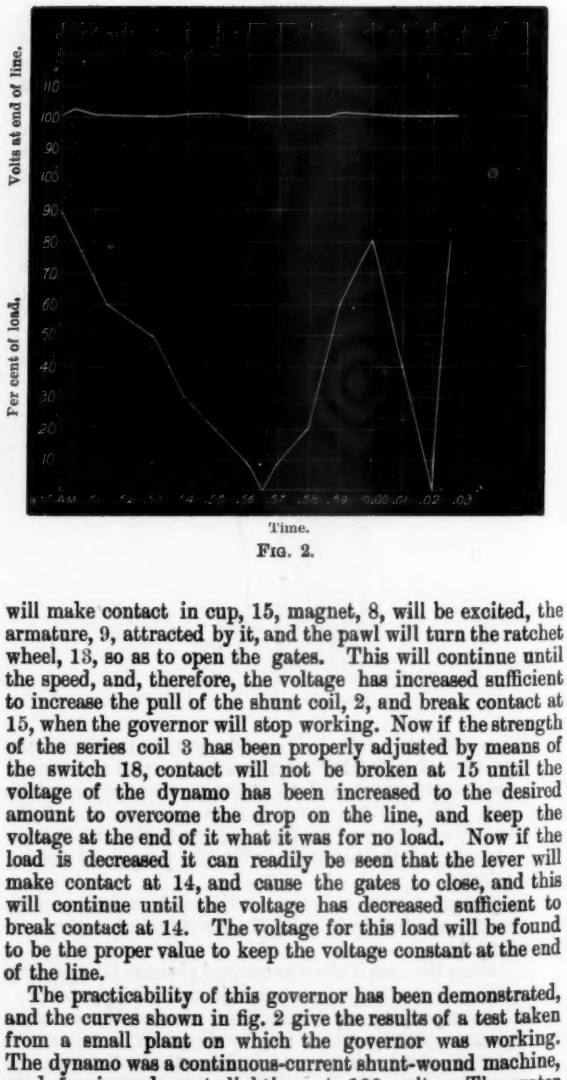


Fig. 2.

will make contact in cup, 15, magnet, 8, will be excited, the armature, 9, attracted by it, and the pawl will turn the ratchet wheel, 13, so as to open the gates. This will continue until the speed, and, therefore, the voltage has increased sufficient to increase the pull of the shunt coil, 2, and break contact at 15, when the governor will stop working. Now if the strength of the series coil 3 has been properly adjusted by means of the switch 18, contact will not be broken at 15 until the voltage of the dynamo has been increased to the desired amount to overcome the drop on the line, and keep the voltage at the end of it what it was for no load. Now if the load is decreased it can readily be seen that the lever will make contact at 14, and cause the gates to close, and this will continue until the voltage has decreased sufficient to break contact at 14. The voltage for this load will be found to be the proper value to keep the voltage constant at the end of the line.

The practicability of this governor has been demonstrated, and the curves shown in fig. 2 give the results of a test taken from a small plant on which the governor was working. The dynamo was a continuous-current shunt-wound machine, used for incandescent lighting at 100 volts. The water wheel was a Burnham turbine, with register gate. The drop

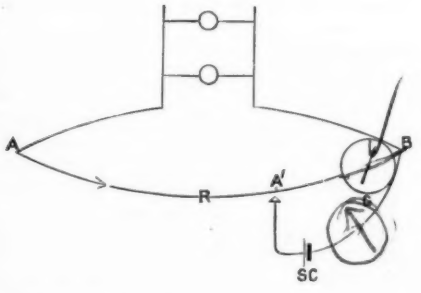
on the line was 7 per cent. at full load, and a constant voltage was desired at the end of it. The readings shown by the curves were taken at the end of the line, and show very plainly that under extreme variations of load the voltage was kept practically constant, the difference between the highest and lowest reading on the voltage curve being only two volts.

EXACT MEASUREMENT OF VOLTAGE, CURRENT AND RESISTANCE.

Writing to the *Electrical World*, Mr. John C. Black says:—

"In the *Electrical World* 'Digest' of July 20th, under the heading 'Units, Measurements and Instruments,' is an abstract of an article by Mr. Thiermann in the *Electrotechnische Zeitschrift* of June 27th. This article treats of an apparatus for the exact measurement of voltage, current, and resistance. The accompanying diagram is a simple modification on the same principle, and explains itself.

"To enter into some detail, A and B are the points at which the difference of potential is to be measured, R an adjustable resistance, G a galvanometer, and S C a standard cell of known voltage, the current to flow in the direction indicated by the arrows. To make the measurement, the adjusting arm of the cell, A′, is made to 'put in' or 'cut-out' resistance in R, and so varying the potential between the terminals, A′ and B, and when such a resistance is cut



out that the galvanometer shows no current, then the difference of potential between A′ and B and that of the cell must be the same, and by finding the ratio of the 'cut-out' resistance to the resistance in R, and multiplying by the voltage of the cell, the potential between A and B is given. An example clearly shows this to be true.

"If R is 500 ohms and the 'cut-out' resistance is 5 ohms, and the cell has a pressure of 1·1 volt, then 500/5 × 1·1 equals 110 volts between A and B, the drop being 1·1 volt per 5 ohms.

"This method is much simpler than Mr. Thiermann's, for the reason that R can be comparatively small to measure even high voltages. The limit to which it can measure can be almost indefinitely increased by either adding cells or increasing R or its power to measure small voltages by the reverse process. This could be called the 'Single Loop Method,' to distinguish from Mr. Thiermann's 'Double Loop Method.'"

ELECTRICAL COMMUNICATION BETWEEN LIGHTSHIP AND SHORE.

In the articles on this subject which have recently appeared in our columns, reference has been made to two patents which have a direct bearing upon the question at issue. One, granted to Willoughby Statham Smith and William Puddicombe Granville in 1892, is entitled, "Improvements in effecting Electric Telegraphic Communication applicable especially for Telegraphing to Lighthouses, either floating or on rocks, at a distance from the Shore, or for Telegraphing to and from Vessels"; the other, granted to Lucien Ira Blake in 1894, is for "Improvements relating to the Transmission of Telephonic Messages between the Shore and a Lighthouse, Ship, or other Signal Station."

Both systems are operated by inductive currents; in each the use of transformers plays an important part, and it is said that because the telephone has been declared to come under the designation of a telegraph instrument, the first-mentioned specification anticipates that of Blake, but in this respect we cannot forbear expressing the opinion that we altogether doubt if such a claim of anticipation were made whether it would be held valid in a court of law.

The Smith-Granville patent is an improvement upon a former specification taken out by Mr. Smith in 1887.

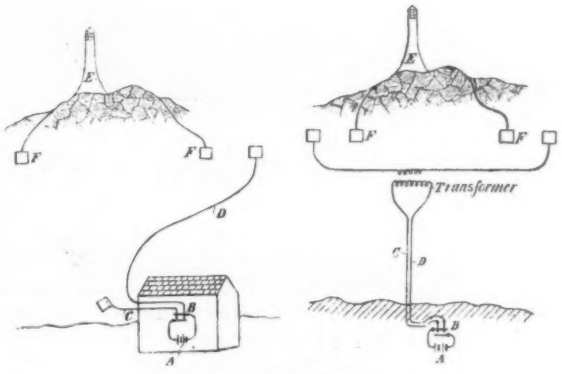
In this system communication was effected between the sending station and distant point without their being in metallic connection one with the other.

Two insulated conductors were led, say, from the shore to the vicinity of a rock; these were coupled at their sea ends to two earth plates or metallic masses, one submerged on one side of, and at a distance from the rock, and the other similarly submerged on the opposite side. On the sides of the rock two earth plates or metallic masses were submerged, and from these insulated conductors were led and coupled to the terminals of a telephone. With this arrangement, when an alternating or frequently interrupted current was passed through the insulated conductors from the shore, the telephone on the rock was affected, and in this way signals were communicated, and *vice versâ* from rock to shore.

It was found that communication could be carried on in this way with one submerged terminal mass only, in the vicinity, say, of a rock, with a single insulated conductor leading to it, whilst the other submerged mass or earth plate is close to the shore or sending station.

The method of communication might be, as before, by means of a telephone as the receiving instrument, or by any other sensitive arrangement; for instance, by an ordinary mirror speaking galvanometer and ordinary reversing key.

This arrangement is shown by the diagram, fig. 1. In this diagram, A is the battery at the shore end, B, an ordinary key mechanism for sending reversed currents through the line, C is a conductor leading to a terminal mass submerged near the shore or sending station, and D, a conductor leading to a terminal mass submerged near to the rock or distant station. This terminal mass may conveniently be a bronze or copper mushroom anchor, weighing, say, two or three hundred pounds or more, having the copper conductor of the cable permanently secured to it. E, lighthouse on the rock, F, F, terminal masses from which conductors are led to the lighthouse.



Figs. 1 and 2 (Smith).

The key mechanism, B, is formed of two parallel finger keys, situated between two fixed bars, one of which bars is coupled to one pole of the battery, and the other bar to the other pole, whilst one finger key is coupled to one conductor of the line circuit, and the other to the other conductor. Normally, both keys are held by springs into contact with the upper bar, and no current passes, but if either finger key is depressed current passes; in one direction if one finger key is depressed, and in the opposite direction if the other key is depressed.

It was found that if the rock is at a considerable distance from the shore, the transmission of signals was greatly facilitated by submerging as near as practicable to the rock a transformer which has its primary or high resistance circuit coupled to the two insulated conductors from the shore, as

shown by diagram, fig. 2, or to a single insulated conductor and earth plate, or metallic mass, whilst the ends of the secondary or low resistance coil are coupled to two insulated conductors leading to two submerged earth plates or masses in the vicinity of the rock. The transformer was constructed in such manner that the current in the primary circuit was transformed down into the secondary circuit from high voltage and low current to low voltage and high current principally, so that the secondary circuit offered a path of very low resistance, and thus formed an easy path for the current from or to the rock, whilst at the same time it obviated the necessity of using a cable having an abnormal weight of copper. A transformer might also conveniently be used on the rock, so that the primary circuit—that is that which is connected to the battery on the rock—is of such resistance as will prevent undue current from the battery, and yet by transforming down, will produce large current of low voltage in the low resistance secondary. This arrangement is shown in fig. 3.

Another great advantage in using transformers as above described, is that any permanent current passing along the insulated conductors leading from the submerged plates (and necessarily there will always be a small current passing from one to the other) will not affect the receiving instruments, and for this reason, when the circuit from the shore is not entirely a metallic one, a transformer may be used at the shore end also.

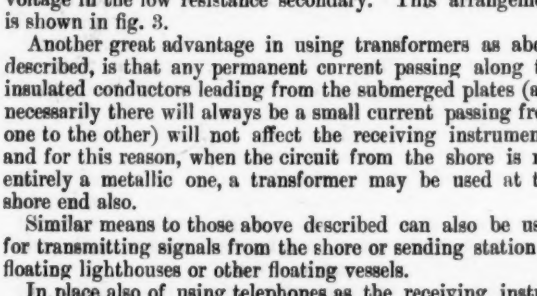
Similar means to those above described can also be used for transmitting signals from the shore or sending station to floating lighthouses or other floating vessels.

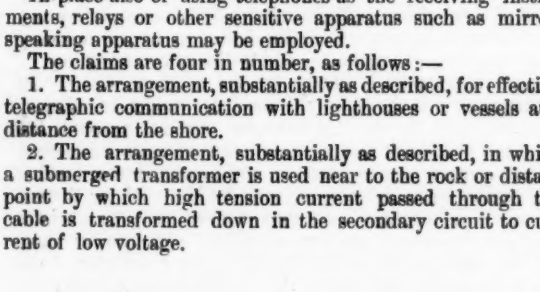
In place also of using telephones as the receiving instruments, relays or other sensitive apparatus such as mirror-speaking apparatus may be employed.

The claims are four in number, as follows:—

1. The arrangement, substantially as described, for effecting telegraphic communication with lighthouses or vessels at a distance from the shore.

2. The arrangement, substantially as described, in which a submerged transformer is used near to the rock or distant point by which high tension current passed through the cable is transformed down in the secondary circuit to current of low voltage.





Figs 1 and 2 (Blake).

3. The arrangement, substantially as described, for effecting telegraphic communication with lighthouses or vessels at a distance from the shore.

4. The arrangement, substantially as described, for effecting telegraphic communication with lighthouses or vessels at a distance from the shore.

It will be noticed that there is no reference in this specification to the use of the telephone for speaking; a telephonic *receiver only* is employed, and that for the reception of signals, not spoken words. It will also be noticed that there is no specific claim for any of the apparatus made use of, but only general claims to the "arrangements as substantially described."

Now for the second specification. Mr. Blake admits that it was well known, prior to his invention, that electric currents suitable for operating sensitive signalling instruments could be transmitted through an insulated metallic conductor submerged in the water or buried in the earth, even though the conductor contained a break, the continuity of the conducting path for a short distance being preserved by the water or the moist earth between the terminals of the conductor at the break.

Mr. Blake is also aware that it has been proposed to take advantage of this fact in systems of electric signalling between the shore and lightships or isolated lighthouses, but so far as he is aware, no practically successful results have been secured by signalling systems of this nature heretofore proposed, nor has the transmission of articulate speech under such conditions ever been accomplished.

It is also a recognised fact in science, if the two terminals of an electric circuit from a source of current be immersed in a body of water, that around each of them for a certain distance an electrified or active region will be established in which there will exist a difference of potential between different points; and the inventor claims to have discovered a practical method of transmitting articulate speech between a shore station and a lightship, or any other vessel or station, by establishing under and around the ship or station a large electrified region between the different parts of which there exists a suitable difference of potential, and providing a metallic conductor to be carried by the ship, and the ends of which may be immersed in such region to connect two points therein between which such difference of potential exists. He found, when the conditions hereinafter stated are properly observed, that a suitable telephone included in the circuit of the conductor carried by the ship will respond to variations of potential between any two points in the electrified region, and that when such variations are caused by

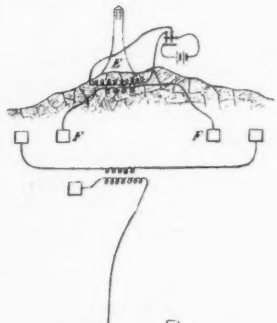


Fig. 3 (Smith.

the voice of a person speaking into a suitable telephonic transmitter the words may be clearly produced. Further, he has proven by experiment that it is possible to greatly extend this electrified region, and to obtain it in different forms suitable for special purposes, as will be hereinafter described.

In order to describe in detail the manner in which he carried out his invention, the accompanying drawings are reproduced.

Fig. 1 is a diagram of the general plan of carrying out the invention.

Fig. 2 is a similar diagram of a modification of the same.

In fig. 1, which illustrates the general plan, where A designates a shore station, and S a station more or less remote therefrom, and which is, or may be, a lightship, or any other vessel or the like.

At the station, A, is a battery, B, a telephonic transmitter, C, and a receiver, D. The batteries and telephones may be, and in the present case are, shown as connected up in a local circuit, the line being a secondary or induced circuit through the secondary, F, of a suitable step-down induction coil, or one in which a current of high potential in the primary is converted to a current of lower potential in the secondary.

In the claims, although these transformers are not specified as an element, they are to be considered as included where their presence, by reason of the length of cable or insulated line, or the extent of the region of communication, is rendered desirable or necessary. It must also be understood that the said transformers may be located at any proper point in the circuit to produce the desired effects.

The line is an insulated cable or conductor, G, grounded at E, at or near the shore station, A, and extended out as indicated to the desired location of the electric region to a submerged plate or conducting body, which, in the present instance, is shown as the anchor, E^1, of the vessel, S.

If the electrified area of communication is to be at a long distance from the shore, the step-down transformer is preferably placed at or near the point where the cable is bared or grounded for the purpose of producing such electrification of the water; and in such case, of course, a step-up transformer may be used at the shore station in order to increase the potential necessary to carry the impulses through the long line. The object in using the step-down transformer is to reduce the potential and correspondingly increase the quantity of the current throughout the electrified area; since the extent of this electrified area will depend largely upon the strength of the current.

It appears with the arrangement illustrated, and when electric impulses are transmitted over the circuit, that an active or electrified region, which may be designated the region of communication, is established in the water around each terminal plate, and that a difference of potential exists between any two points therein at unequal distances from either terminal plate. The two immersed terminals of the cable may be at a very considerable distance apart, even to many miles, and wholly independent of each other, so that no current actually flows from one to the other; but if from any vessel as S, lying at any point in one of these regions of communication, the ends of a conductor, K, be let down into the water so that it connects two points at unequal distances from either terminal, E and E^1, electric impulses will pass in said conductor corresponding to those transmitted through the cable from the shore station, A. A suitable telephonic receiver in the conductor, K, will reproduce the signals or speed thus transmitted.

Instead of including the transmitter on the ship directly in the conductor, K, it is desirable to employ a transmitter, C^1, and a battery, B^1, in a local circuit, including the primary coil of an induction coil, the coil of low resistance of which is in the circuit of conductor K.

Mr. Blake found it necessary, however, in order to transmit speech in this way, to employ telephonic receivers specially constructed of exceedingly low resistance, in comparison with ordinary telephones, and determined for each case by the size of the terminal plates of the conductor, K, and the specific conductivity of the medium in which they are immersed.

He found it expedient ordinarily to employ a telephone in his receiving circuit, with a resistance as low as 1 ohm, or preferably less than this—even as low as $\frac{1}{10}$th of an ohm. Such a telephone is readily made by using a larger wire than that used on the ordinary telephone, and decreasing the number of turns.

The resistance of the receiving telephone will also be determined to some extent by the nature of the medium in which the work is being carried on. The resistance of salt water being many times less than that of fresh water, it follows that, with a given distance between the terminal plates of the receiving circuit, there will be a greater difference of potential in fresh water than in salt, and consequently a higher resistance can be permitted in the receiving circuit as a whole, and of course in the receiving telephone as a part of such circuit.

So, also, the size of the terminal plates of the receiving circuit should be made as large as possible, in order to reduce the total resistance of that circuit; and the lower the total resistance of such circuit, the lower should be the resistance of the telephone forming a part of it.

It is not only possible to transmit in this way signals from the shore to a ship, but also from the ship to the shore.

The region of communication may be greatly extended and directed by exposing the conductor of the insulated cable at suitable intervals, or providing local terminal plates, M, at intervals along its course, as shown in fig. 2, or employing a bare conductor, M^1, in lieu of the plates. In this case each plate or exposed portion of the conductor serves as a terminal or point from which the electrical influence is diffused.

In practice, the inventor has found that with a bare copper wire of suitable low resistance, he could develop the region of communication for about a mile or more along the direction of the wire, and for several hundred feet all around it, and obtain in a telephonic receiver, D^1, clearly audible speech when the ends of a short conductor, K, including the same, are immersed at any two points in the body of the water unequally distant from the wire, and within the above limits.

The length of the conductor, K, may be very short compared with the total distance between the terminals of the cable, and the length of an ordinary ship is ample to secure good results.

The claims are as follows:—

1. The combination with a source of current, and transmitting instruments at a shore station and an insulated submarine conductor or cable, bared or exposed to the water at two or more points so as to establish an electrified region of communication, of a conductor having its ends immersed at two points of different potential in said area and a telephone of low resistance in circuit therewith, said telephone and conductor being carried by a lightship or other vessel, or connected with a lighthouse or other signal station, as set forth.

2. The combination with a source of current, and signalling instruments located at a shore station, and a submerged cable or insulated conductor extending from such station and grounded or exposed to the water at said station, and at intervals along its course, of a conductor having its ends immersed at two points unequally distant from any one of the points at which the cable is exposed, and signalling instruments connected with said conductor, the said instruments and conductor being carried by a lightship or other vessel, or connected with a lighthouse or other signal station, as set forth.

That these patents are quite distinct from one another seems clear, if we take one point only, the method of transmitting electrical impulses. In the Smith-Granville system, impulses are sent out by ordinary reversing keys, that is, there is a make and break in the circuit; in the Blake method the transmission circuit is closed, and acts by variation of resistance; in other words, the former is telegraphic, and the latter telephonic. The declaration that telephony and telegraphy are synonymous terms applies only locally; the application is, moreover, limited by special circumstances, under special laws, and has no relation to patent law. The scope of both the patents referred to seems to us to be fairly defined by the claims, and considering the subjects with which they deal, it is obvious that they must be limited to the obtaining of the results aimed at by the means stated. The first being for telegraphic signals only, would be so limited, and the second being for telephonic speech, would also be limited to the particular combination, as for example, the low resistance telephone of the first claim, and the qualifying, "as set forth," of the second claim.

CORRESPONDENCE.

The I.E.S. Battery.

If Mr. New wished to enable electrical engineers to make comparisons between the I.E.S. and other existing types of battery, why did he not give us some definite data, instead of a vague comparison with an E.P.S. cell, as to which no data are given, except that its plates have the same surface as those in the I.E.S. cell. The comparative capacity per unit of plate surface is of very little practical interest or importance; what we want to know is the comparative capacity, charge and discharge rate per pound of plates and per pound of complete cell.

It is true Mr. New told us that he got 1 ampère-hour per ounce of peroxide plate; a good, but not a wonderful capacity, and certainly not three to five times as great as that of an E.P.S. plate.

The I.E.S. plates I have seen are about $\frac{1}{2}$ inch thick; E.P.S. plates are of various thicknesses, according to the type of cell, from $\frac{1}{8}$th inch upwards.

In his article, "On the Effect of a Perforated Septum of Insulating Material in the Electrolytic Path of a Voltaic Circuit," Mr. FitzGerald has assumed that the internal resistance of a cell is simply the resistance of the electrolyte, but is this known to be the case? During the discharge of an accumulator, the internal resistance increases to several times

its original value, and this increase is far too great to be accounted for by increase of resistance of the acid. Also, if the distance between the plates be increased, the internal resistance will be increased, but in a much smaller ratio. Apparently a large part of the internal resistance of the cell is a "contact resistance" at the surface of the plates, and this surely would be considerably increased by enclosing them in closely fitting perforated envelopes.

G. C. Allingham.

September 4th, 1895.

BUSINESS NOTICES, &c.

Annual Outings.—The employés of the Nalder & Harrison Construction Syndicate, Limited, had their annual outing on Saturday last. The party, numbering about 50, proceeded to Brighton, where a very enjoyable day was spent.

On 24th ult. Messrs. Marryat, Lillywhite & Co. and employées, went for their annual outing. A trip in a steam launch from Kingston to Windsor and back was enjoyed, lunch and dinner being provided at Chertsey.

Business Announcements.—Messrs. J. Lomax Kendal and Co. inform us that they have taken over the business lately carried on by Messrs. Lowcock, Hill & Co., Limited, and Mr. Kendal (having been with the late firm from almost its commencement) has made arrangements to retain the same staff. The new firm will carry out general electric lighting and installation work, and their address will be 2, St. James's Square, Manchester.

We are informed that, in order to meet the demands of their business, Messrs. Marryat, Lillywhite & Co. have taken ground floor, basement, and upper floor offices, at 28, Hatton Garden, also a building in the rear, which is to be converted into a showroom of fittings and machinery.

Bankruptcy Proceedings.—At the London Bankruptcy Court on Monday last a receiving order was made against Mary Ann Hillock, widow, carrying on business as the Medical Electrode Company, at 146, Southampton Row, Russell Square, W.C., who has filed her own petition. The debtor states that she has an agreement to rent the premises at £100 a year, which agreement expires in 1897. A quarter's rent up to June last is in arrear, and the furniture and stock were sold by the landlord three months ago for rent then due, but the debtor has since been allowed the use of them, and there is now stock to the value of £5 on the premises. The amount of the liabilities was not stated, and no assets were disclosed.

Electrical Accessories. — A catalogue of electrical accessories has been sent to us by Messrs. Fuller & Co., of Bush Lane. Tables of the Alpha wires and cables, electric light casings, brackets, pendants, standards, ship fittings, lamps, switches, accumulators, shades, and a great variety of similar electric lighting fittings and accessories is given, along with prices thereof.

Four Years' Pollings.—A very handy and useful little book has been published by the Exchange Telegraph Company, Limited, in which we find a complete record of the results of the polling at the general elections of 1885, 1886, 1892, and 1895. The book also contains a host of testimonials from political bodies and other authorities regarding the efficiency of the company's service during the election which closed a few weeks ago. The price of the book is two shillings.

Messrs. Nalder's New Catalogue.—The catalogues of Messrs. Nalder Bros. & Co. are always very neatly got up and carefully set out, two essentials in a catalogue which is to attract and be of service. The excellent arrangement of reference numbers, descriptions, prices, and code words, in a sort of table form which has been adopted by the firm for a long while—and, we believe, since adopted by others—puts the necessary details together in a very concise and ready manner. They have now issued the sixth edition of their price list of electrical testing, engineering, mathematical, optical, and other scientific instruments. There is given a short and handy telegraphic code at the commencement of the book, and among the general matter further on are included several things which have not appeared in previous editions, and which are worthy of notice. Of some apparatus Messrs. Nalder have made special modified or improved forms and designs which are peculiar to themselves. Under the heading "Standard Cells and Batteries" is the Carhart-Clark standard cell, Messrs. Nalder having a special arrangement with Prof. H. S. Carhart for the manufacture of his cells in Europe. The description of these cells is followed by several pages devoted to various kinds of condensers and electrometers. In the galvanometer section there is a variety of detector, lecture, tangent, and reflecting galvanometers of both the D'Arsonval and Kelvin types, also shunts and accessories. The N.C.S. pattern D'Arsonval galvanometer, with Ayrton-Mather coil, is a very sensitive instrument, and is stated to be the only type of galvanometer which can be used where local magnetic fields render the use of a Kelvin instrument impossible. The N.C.S. pattern four-coil astatic Kelvin galvanometer, which follows, is intended to meet the demand of engineers and others for a Kelvin galvanometer of the same sensitiveness as the brass case four-coil galvanometers. This instrument was described in our issue for February 15th last. Lord Kelvin's own type of this galvanometer is also included. There is a new design of N.C.S. lamp-stand and scale, which allows for a large range of height of mirror, and can be used with plain or transparent scales, and with either oil, gas, or electric illumination. Under shunts, needles, &c., there is a universal shunt for all galvanometers, which has been designed by Prof. Ayrton and Mr. Mather. Prof. Unwin's extensometers are listed; we note that the Professor's certificate is given with these instruments. Further on in the book, in addition to a great quantity of other apparatus, is Profs. Ayrton and Perry's variable standard of self-induction, an astronomical chronograph with isochronous pendulum and inertia governor combination, the high speed tuning fork chronograph, magnetometers, magnetic curve tracer, calorimeters, pyrometers, thermopiles, telescopes, mirrors, prisms, and achromatic object glasses. In the section devoted to resistance coils and Wheatstone bridges, &c., we may mention the N.C.S. copy of standard ohm, and the R. 223 standard resistance coil, which is specially designed for incandescent lamp factories; and further on in the list we observe the N.C.S. Kelvin double bridge, which was described in the Electrical Review, October, 1894. Towards the end of the book are several new items, including the N.C.S. pattern dial coils (R. 395) and the N.C.S. pattern ratio coils (R. 401), the former having been brought out to meet the demand among engineers for coils for commercial work, and for the purposes of technical education. The N.C.S. new test set (R. 404) is a combined set of two bridges, one for copper resistances and the other for insulation measurements. The last item of all, "Photometers," is interesting, in that from it we learn that Messrs. Nalder are the sole makers of Trotter's portable direct reading photometer (for which a patent is being applied for), Mr. A. P. Trotter having promised to calibrate and certify each instrument. We have only space to notice briefly a few of the instruments described in this catalogue. The compilation of the catalogue is a credit to the firm, the printing of blocks and everything else being all that could be desired. The few items we have mentioned will serve to show our readers, if they do not already know it, what an extensive class of intricate apparatus Messrs. Nalder Bros. manufacture.

Mr. Mensing's Catalogue.—Mr. L. C. H. Mensing, of the City Electric Light and Power Engineering Works, Worship Street, E.C., has sent us a copy of his new catalogue of dynamos, arc lamps, motors, and alternators. In regard to illustration, we consider some of the blocks are excellent, and a glazed paper having been used, they show up to perfection. The letterpress and general arrangement do the compiler credit. Dynamos, motors, and transformers, occupy the greater portion of the work, and are followed by descriptions of direct coupled plants, arc lamps, and accessories. A feature of special importance is the large amount of general information which is included regarding the plant described, and which gives the publication the character of a useful text-book as well as a catalogue. The general description of dynamos and motors, which cannot fail to be very instructive and useful to customers, is made the more interesting by a number of diagrammatic and sectional drawings, as well as the photographic views to which we have referred. In Section 1 is given a list of dynamos for belt or rope driving, a brief specification of dynamo-electric machines being included, also tabulated details regarding two-pole and multipolar dynamo machines, their speed, output, weight, &c. Tabulated information is given further on of two and four-pole electromotors, along with dimension table for motors, and full particulars as to prices, also tables regarding alternators, transformers, and coupled plants. The dynamos and arc lamps described are specialities of Mr. Mensing's. Prices are also given of Willans engines. A copy of a testimonial received from Mr. William Whiteley is at the end of the book.

Mr. Robert W. Paul's New Catalogue.—From Mr. Robert W. Paul we have received advance sheets of his new catalogue of electrical testing and measuring instruments and sundry physical apparatus. We observe the catalogue will contain descriptions of a considerable number of new patterns of instruments which, we understand, originated in his workshops. There are sections devoted to resistances, galvanometers, testing sets, condensers, batteries and electrometers, testing switches, and keys. From these headings it will be evident to our readers that the book necessarily contains a large quantity of particulars regarding a great variety of apparatus. The many articles described are illustrated by neatly prepared blocks, and prices are given of nearly every article. Mr. Paul's catalogue will be found of use by his customers.

New British Electric Installation Company.—In the Worcester County Court last week, Mr. Bell, London, applied on behalf of Mr. J. L. Fuller, engineer, of Cannon Street, London, for an order to wind up the New British Electric Installation Company, who were indebted to him in the sum of £85. The petition stated that the company had a capital of £20,000, but on the shares taken up only £1,075, and no more was subscribed. The new company purchased the business and assets from an old company for £3,000, for which amount 6 per cent. debentures were created in favour of the old shareholders as supplementary capital. In July of the present year the debenture holders claimed the whole of the assets of the company, and Mr. Justice Kekewich appointed Mr. H. Leicester receiver. The petition alleged that the old company was insolvent and its shares valueless. The new company had been formed for the purpose of converting the shareholders in the old company, who were debtors to that company as holders of shares credited as fully paid up, but in respect of which no cash had been paid to secured creditors of the new company. Mr. Beauchamp, speaking on behalf of the company and the debenture holders, but not actually opposing the petition, did not know whether it was desirable that another receiver should be appointed to wind up. The assets were very small, and hardly enough to pay the costs of the winding up. His Honour thought it undesirable that there should have been two enquiries regarding the matter, but he granted the petition, by which the Official Receiver becomes the liquidator.

The Robertson Incandescent Lamps.—The General Electric Company, Limited, who are the sole selling agents for these lamps which are manufactured by the Incandescent Electric Lamp Company, Limited, at Brook Green Works, have sent us an illustrated list giving prices and illustrations of various patterns of the Robertson lamps and standard terminals. There are diagrams included, giving illustrations and dimensions of standard bulbs, prices and particulars of long life, high candle-power, economic, candle, tubular and battery lamps. Photographic illustrations, showing various departments at the company's lamp works are also contained therein.

The Universal Directory of Railway Officials.—We have received a copy of the first issue of the Universal Directory of Railway Officials, which is published by the Directory Publishing Company, Limited, of 8, Catherine Street, Strand, W.C. The Directory contains the names and official addresses of upwards of 8,500 directors and chief officials of railways in all parts of the world, including the chief clerks and chief draughtsmen of the principal British, Colonial, and Indian railways. It is also, in addition, indexed for (1) countries; (2) names of railways; (3) names of railway officials; (4) names of manufacturers of railway supplies. The directory is compiled from official sources, and the price is 10s.

The Electric Trust, Limited.—The creditors of the above company are required before October 14th to send their names and addresses and the particulars of their debts or claims, and the names of their solicitors (if any) to Frederick Cross, of 9, Bridge Street, Westminster, the liquidator of the company.

The Swan Fountain Pen.—Years ago a certain pen came as "a boon a blessing to men." Whether the same sentiments exist at the present day concerning "Owls" and "Waverley's," we know not, but the Swan fountain pen, which we have recently adopted, is a real blessing, and to those who, like ourselves, have much writing to do, we cordially recommend the article.

Lamp Shades.—A revised catalogue of silk lamp and electric light shades has been issued by Messrs Louis Dernier & Co., of London, W. There is a large assortment of pretty designs, many of which are new, and prices of same are also stated.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The annual accounts of the gas and electric lighting departments of the Town Council for the year ended July 31st, 1895, gave the following particulars regarding the electric lighting:—The amount authorised to be borrowed under the authority of the Secretary for Scotland is £25,000, and that there has been borrowed on mortgage £19,900, leaving a balance not exercised but provided by temporary loan of £5,100. The revenue and expenditure account shows an income from sale of current by meter of £2,704 17s. 8d., an income from public lighting of £154 12s. 8d., and for rent of meters £115 13s., making a total of £2,975 3s. 4d. The principal items of outlay are fuel, wages, and salaries of engineers. There is a balance carried to net revenue account of £1,815 17s. 10d. In interest on mortgage and other loans there is a payment of £656 2s. 10d; a sum of £730 0s. 11d. is charged for depreciation for seventeen months, and sinking fund at 2 per cent. for seventeen months absorbs £538 17s. 2d., making a total of £1,925 0s. 11d. The loss on the department for the year is £109 3s. 1d. The balance at debit at July 31st, 1894, was £292 6s. 10d., and this year's loss makes the total £401 9s. 11d. The gas department paid in respect of loss to December 31st last a sum of £217 15s. 6d., and the balance of the £401 9s. 11d., amounting to £183 14s. 5d., is carried to next year's accounts. The statement of electricity generated, sold, &c., shows that the quantity generated in B.T. units was 118,193. The total sold was 106,285, of which 8,163 was for 10 public lamps and 98,122 for private consumption. The quantity used in the works was 1,570, the quantity not accounted for is 10,338.

Alderley Edge.—The District Council has spent £272 7s. 2d. in securing its provisional order, and now Mr. S. V. Clirehugh, electrical engineer, of Manchester, has written offering to buy the provisional order, stating he was authorised by his clients to offer in return for the order to pay the costs incurred by the Council in obtaining it, and to say that his clients were prepared to supply electricity for lighting purposes at the cost of 32s. 6d. per lamp. The clerk stated that the cost per lamp at present was 35s. The matter was also referred to the Finance Committee for consideration.

Belfast.—The engineer, Mr. M'Cowen, recently reported that upwards of 7,000 lights are in use and applied for. Extensions are proceeding in the neighbourhood of College Square East towards the new theatre.

Blackpool Electric Lighting Matters.—An important discussion took place at the Town Council meeting on Wednesday. The Electric Lighting Committee recommended extensions to the tune of £30,000, that Mr. Robert Hammond, the Council's adviser, prepare specifications for these extensions, and the money be borrowed. There was a very lengthy discussion, in which a variety of resolutions were suggested, but in the end the extensions were deferred for twelve months, and Mr. Robert Hammond's services as consulting engineer dispensed with, as it was considered a consulting engineer was unnecessary. The mover of this motion said, "The leading interest of a consulting engineer was to advise the expenditure of new capital." We have heard that there is a rumour about that the delay in passing the vote for £30,000 is only until the results of the November elections (at which the chairman of the electric lighting committee, Mr. Councillor Pearson, again goes before the electors) are known.

Bangor.—The Council has resolved to apply for the necessary legal powers, and to empower the Electric Lighting Committee to carry out a scheme for the electric lighting of Bangor at once, "so as to be in a position to open the electric lighting works at the end of the year 1896." The Council has also accepted Lord Penrhyn's offer to sell, conditionally, the freehold of a field near the police station for £400 for the site of the electric light works.

Battleship Lighting.—The electrical machinery of H.M.S. *Majestic*, which is now completed, is, we learn, of a very elaborate character, consisting of three sets of engines and dynamos of 600 ampères, with a potential load of 80 volts.

Brazil.—Plant is to be put down for the electric lighting of Santa Rita de Passa Quatro.

Broadstairs and St. Peter's.—The District Council has declined the offer made by Messrs. Harrod to furnish an electric lighting report, and has also replied to the Town and Village Electric Lighting Company, Limited, that at the present moment they cannot take into consideration the company's communication advocating the adoption of their system.

Cheltenham.—Electric current was turned on at the Public Library on Monday last week with the usual ceremony. Altogether there are about 140 lamps, giving a total of 2,712-C.P. 52 of these lamps are in the reading room, 26 in the reference library, 16 in the basement, eight in the corridor; 16-C.P. lamps are used over the reading tables, and 8-C.P. over the newspaper stands. The entrance hall has a handsome electrolier, the gift, as we have already stated, of Baron de Ferrieres. The work was carried out by Messrs. R. E. & C. Marshall, who also designed and supplied the electrolier referred to.

Alderman Norman stated at the last Council meeting that the electric light was being taken up by private consumers more largely than the most sanguine members of the committee had anticipated. In accordance with the committee's minutes and the electrical engineer's report, it was decided to put in hand the lighting of the Promenade and certain streets with 50 arc lamps. Those in the Promenade should be placed 40 or 50 yards apart, and those in the other streets 70 or 80 yards apart.

Exeter.—At a special meeting of the City and County Council, it was decided to enter into negotiations with the Exeter Electric Light Company with a view to acquiring their undertaking. The mover stated that a London company had been offered the shares and debentures in the company for a sum of £7,000. A committee will consider the various details.

Halifax.—The electric lighting at the Theatre Royal is being extended to the stage, orchestra, and other departments; Messrs. W. Emmott & Co. are carrying out the work.

Hampstead.—The Vestry Clerk, in his report on the work of the Vestry for the year ended March 25th, records the history of the electric lighting operations since the laying of the foundation stone on May 23rd, 1894.

India.—We learn that the Municipal Authorities at Bankipore contemplate lighting part of the town by electricity.

Japan.—The Kyoto Electric Light Company has declared a dividend at the rate of 18 per cent. per annum for the first half of the present year, while for the same period the dividend of the Tokyo Electric Lighting Company is at the rate of 8 per cent.

Kingston.—On and after January 1st, 1896, the Corporation has decided to charge only 4d. per unit beyond a certain amount to large consumers.

London.—The question of lighting the Mile End Workhouse by electricity has been deferred for the present.

Oldham.—Last week, a Local Government Board inquiry was held here into the application of the Corporation for sanction to borrow £15,000 for the purposes of electric lighting. No opposition was offered.

Portsmouth.—A local pressman has interviewed Alderman Ellis, J.P., the chairman of the Electric Lighting Committee, and from the remarks made it seems that orders are pouring in, but owing to the efficiency of the lamps sold by the Corporation, there is much less current consumed per lamp than when the fittings and lamps used by private consumers were obtained from ordinary contractors. Owing to this, on the second half-year's working the committee have found that there has been a large reduction in people's bills, and consequently a reduction in the income. In some instances tradesmen are finding their lighting bills are less, and the light appears to give general satisfaction. From September 29th the price of the electric light will be reduced from 6d. to 5d. per unit. The work of extending the electric light mains throughout the borough is now in progress. At present the cables finish at South Parade, but they are to be carried through East Southsea. Within eight or nine weeks' time it is hoped to have the whole system finished, so far as the incandescent lamps are concerned, and the arc lamps will, it is expected, be fitted by the end of October.

Redcar.—Mr. Stacey, electrician (Sheffield) recently attended to ask the District Council to grant him a concession to lay down electric light plant in the town for the purpose of forming a limited company to supply Redcar with electric lighting. On the motion of the chairman the concession was granted.

Salford.—The Town Council having applied to the Local Government Board for sanction to borrow £18,000 for electric lighting purposes in the borough, an inquiry into the matter was held last week. The Town Clerk explained that there had already been an inquiry into an application to borrow £50,000 for electric lighting purposes, and the Council hoped that it would not be necessary to hold any further inquiry. On that occasion sanction was granted for the borrowing of £32,000, in respect of which estimates were submitted by the Corporation. The £18,000 now applied for was the balance of the £50,000, and he was afraid they were in a similar position to that occupied at the last inquiry. It was proposed to spend something approaching a half of the £18,000, in accordance with estimates which were submitted, and the Council hoped it would not be necessary for another inquiry to be held with regard to the balance. The Inspector said, although he could not pledge the Local Government Board to anything, he saw no reason why another inquiry should be held for the balance of the £18,000. Of course, at present, sanction could not be expected for a greater amount than that for which definite proposals were submitted. Mr. Edward Manville, electrical engineer, said the works already carried out were in accordance with the plans originally submitted. The balance of the £50,000 was now required for carrying out certain extensions of the undertaking. Mr. Manville explained details of the work for which part of the £18,000 is required, and the inquiry then closed.

Spain.—A central electric lighting station has lately been completed and put in operation at Puentereas, in Pontevedra province. The plant comprises a turbine and an alternating dynamo giving 19½ killowatts, water power being utilised.

Stafford.—The engineer has reported that the electric current will be ready for public supply by 25th inst., and a sub-committee has been appointed to make the necessary arrangements connected with the ceremony.

Witton Gilbert.—After a long discussion, the Parish Council the other day resolved that the whole parish of Witton Gilbert be lighted by electricity, and a committee was formed to go over estimates received and report to a meeting of the Council to be held on Wednesday, September 4th.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Derby-Ashbourne Proposed Electric Railway.—Mr. John Shaw, jun., an engineer of Derby, has, with the assistance of Messrs. Dickinson, of Birmingham, formulated a scheme for the construction of a light electric railway between Derby and Ashbourne. The estimated cost of the line would be about £1,000 per mile of permanent way. Electric signalling would be adopted, the cars being lighted by electricity. The rolling stock would consist of motor cars, trailers, and goods cars. Each motor car would be equipped with 20 E.H.P. motors, and would cost about £600 each. Trailing cars which would be only used in the summer would cost about £200 each, and the goods cars about £100 each. The entire cost of the line is estimated at £62,300. The proposed line is looked upon as likely to aid agricultural operations in the district.

Electric Traction in Spain.—The electric tramway between Bilbao and Santurce is now so far completed that the trial runs are about to be made.

Electric Traction in Germany.—It is proposed to construct an electric tramway between St. Andreasberg and Clausthal-Zellerfeld, in the Upper Hartz district.

Electric Traction in France.—It is proposed to construct a line of electric tramway between Havre and Montevilliers. An electric tramway has just been completed and put in operation between Roubaix and Wattrelos. The question of a system of electric tramways in the Periguex district is again under consideration. It is proposed to construct two lines of electric tramway in the town of Soissons (Aisne).

Electric Railway Business in America.—According to the *Electrical World*, draughtsmen are busy at the Baldwin Locomotive Works working upon plans for the trucks to be used with the new type of electric locomotives which the Baldwin-Westinghouse combination intends producing. A locomotive after the new design will be ready for inspection in about three weeks. Two trucks will be made—one for light work and elevated roads, the other for the heavier class of suburban traffic, suitable for hauling 12 or 15 cars. These trucks can, it is claimed, by fitting them with motors of different power, be made to serve all the requirements of electric roads, from the lightest elevated, with a maximum speed of 40 miles an hour, to the fastest suburban work of 90 miles an hour.

The *Financial News* states that the construction of the Washington and Alexandria, Virginia, Electric Railway has been commenced. The trolley will be used outside of the city and the underground inside. In crossing the Potomac the tracks of the Pennsylvania Railroad will be used, and it is understood that as soon as the road has been completed the local passenger trains of the Pennsylvania Company between Washington and Alexandria will be withdrawn. The road is expected to be completed by December.

Storage Battery Cars in America.—An American Exchange states that during next month some improved storage battery cars will be brought into use upon the lines of the New York and Harlem Railroad Company. A few years ago this company ran some Julien storage battery cars, but owing to the storage battery litigation then existing the experiments were abandoned. The success of storage battery cars in Paris, and the settlement of all legal entanglements, have led the New York and Harlem Company to resume its experiments. The new cars will be equipped with chloride accumulators. The general design of the cars which are now being built includes some novel features. The batteries will not be carried in the car body, as has been the practice heretofore, but will be suspended from the truck under the centre of the car. The tray or box containing the batteries is readily and quickly detachable from the truck and removed, for the purpose of charging, on a small transfer car running on rails to and from an elevator situated between the street-car tracks and running beneath the floor to a cellar or subway, the elevator being adapted to hoist the batteries into place on the car truck, or to remove them therefrom, as the case may be. By this novel arrangement, our contemporary states, a car can be loaded and unloaded in about half a minute. It will be seen that with this new system of carrying the batteries on the truck any car body is adapted for use in this service, thereby saving a company adopting the system considerable expense by enabling it to use its present car bodies. The cars will have 18-foot bodies and will be mounted on Peckham trucks. The electrical equipment will be that of the General Electric Company.

The Portrush and Giant's Causeway Electric Tramway.—At the recent meeting of the Municipal and County Engineers, Mr. Traill, the engineer of this tramway, gave some details regarding the working of his line. He stated that when the Portrush electric line was first proposed, it was opposed by every authority concerned, so that there was much to contend against. The worst gradient was 1 in 24, and worst curve one with 30 feet radius. The line was opened in 1883, and therefore when viewed with the knowledge of to-day might be improved; but so rapidly did the traffic extend that they had soon to largely use steam as well as electricity in haulage. One of the most interesting points no doubt to the members was the cost per mile, and this, calculated for the 13 years, came to only 3¼d. to 3½d. per mile for the electrical part, while the steam traction cost from 1s. 3d. to 1s. 4d. per mile. "One of the greatest advantages of electric traction was that you could send along car after car, but with steam the engine must go to the end and come back."

Traction in Staffordshire.—At the last meeting of the Stoke-on-Trent Town Council, the Town Clerk read a letter from the secretary to the Tramway Company enclosing a draft agreement embodying the consent of the corporation to the working of the trams by electric traction by means of overhead wires, when it was recommended that before approving the agreement a deputation should visit Walsall, where the overhead electric system is in use, and afterwards that the deputation should be authorised to confer with the Town Clerk, and settle the draft agreement.

TELEGRAPH AND TELEPHONE NOTES.

African Telegraphs.—We learn that telegraphic communication between Umtali and Fontesvilla was established on July 21st. The wire was very freely used at both ends, and the Chimoio people must also have kept their telegraphist busy. We also learn from the *Financial News* that Palapye and Belingwe and district are to be connected by telegraph with Buluwayo.

Brazil Telephones.—The *Financial News* correspondent states that the Prefect of the Federal district has fined the telephone company $500 for irregularities in its service. Oh! for such a Prefect over here.

Cable Laying Gear for a Japanese Steamer.—The twin screw steamer which Messrs. Lobnitz & Co. are about to build for the Japanese Government will be fitted complete with cable laying gear of the most modern design by Messrs. Johnson & Phillips, and also with electric lighting plant and fittings for the whole of the vessel.

Edinburgh Telephones.—The general manager of the National Telephone Company, Limited, has written to the Town Council suggesting that the Corporation should lay down underground tubes for telephone wires at the company's expense.

Halifax Telephones.—The Halifax Chamber of Commerce last week considered the question of the local telephone service, and it was resolved that all the Chambers of Commerce in the districts interested in the matter should complain to the company of the high charges and unsatisfactory service.

Lightning and Telephone Wires.—During a heavy thunderstorm which passed over Cheshire and North Wales the other day, the telephone wires at Chester were severed by lightning.

London-Paris Telephone Business.—In the House of Commons last week, Mr. Henniker Heaton asked the Secretary to the Treasury, as representing the Postmaster-General, whether he was aware that statistics of the telephone business transacted between France and England could be obtained from the French Government; if he would explain why these statistics could not be furnished to the House of Commons, and whether he could reduce the cost of conversation between France and England from 8s. to 2s. 6d. for three minutes without loss to the revenue. Mr. Hanbury, in reply, stated that the Postmaster-General is not prepared to grant these statistics, as he is of opinion that the telegraphic business of the State must be dealt with as a whole, and that it would be misleading to give statis-

tics relating to only a part of the business. The Postmaster-General does not see his way to reduce the cost of conversation between France and England from 8s. to 2s. 6d. for three minutes. Mr. Hanbury took this opportunity of stating that in his question on Tuesday, the fault of saying 3s. in place of 8s. was not the hon. member for Canterbury's, but was due to a printer's error. The reduction of charge, in the Postmaster-General's judgment, would necessarily lead to a loss of revenue from the telephone, which, during many hours of the day, is already fully occupied.

More Cables Wanted.—There is a movement on foot, having for its object the laying of a third telegraph cable between Algeria and Tunis, and France and Corsica. During the past few months there has been so great a development in the use of the telegraph in these parts, that the two existing cables have been found insufficient to carry on the service without delay.

New Cable.—The *Western Mail* says :—"Operations have now been started for connecting Lavernock, the Flat Holm and Steep Holm, and Brean Down by an electric cable for the purposes of the Severn defence. The steamer which has been engaged for the work entered the Roath Dock on Saturday, and the work of excavation will be begun forthwith. The cable will be also connected with the Royal Engineers' Offices in Canton and the Sub-Marine Mining Establishment at the Docks, Cardiff."

Proposed Paris and Rome Telephone.—The French Government, says a Dalziel telegram, is again opening negotiations with the Italian Government for the establishment of telephonic communication between Paris and Rome, *via* Milan and Florence.

The German Telegraphs and Telephones.—Mr. W. H. Preece, C.B., &c., and Mr. Fischer, Chief Superintendent of the Central London Telegraph Office, are now in Berlin studying the German telegraph and telephone systems.

The Telephone in Government Offices.—Telephonic communication between the Colonial Office and the House of Commons has been for some time in existence; but we hear that an instrument has now been placed in the Secretary of State's Department, so that Mr. Chamberlain and his secretaries can be at any time in communication with each other, should necessity arise, though separated by the distance dividing Downing Street from St. Stephen's.

Telephonic Communication in Egypt.—A company has lately been formed to establish and operate telephone exchanges in the Egyptian towns of Tantah, Damanhur, and Zagazig. Exchanges are already in operation at Cairo, Alexandria, Port Said, and Suez, the number of subscribers to which is steadily increasing.

Telegraphic Material in Bulgaria.—According to a recent official report most of the telegraph material used in Bulgaria is supplied by Germany, France, and Austria. England and Russia both participate in the trade, but only to an exceedingly small extent.

Telegraphic Communication in Turkey.—A proposal is under consideration to establish telegraphic communication between Constantinople and the Island of Antigoni.

The Fastnet Rock.—Last week's *Sketch* published excellent reproductions of two photographs taken by Mr. W. P. Granville. One gives a general view of the Lighthouse and Rock, and the other illustrates the method of landing on the Rock by means of a jib, which projects some 100 feet out, so that a boat can be kept clear of the dangerous breakers which are nearly always running close to the rock.

CONTRACTS OPEN AND CLOSED.

OPEN.

Banstead and Colney Hatch.—September 30th. The Asylums Committee of the London County Council is inviting tenders for various works in connection with certain temporary iron structures which are to be erected for them. The list includes a fire alarm and telephone system, also heating arrangements at their asylums at Banstead and Colney Hatch. Particulars from R. W. Partridge, Clerk of the Asylums Committee, 21, Whitehall Place, S.W.

Braila.—October 2nd. The details regarding the tenders invited for electric tramways and lighting the city for the Municipal Authorities of Braila were given in our issue for August 30th.

Dundalk.—October 7th. The Town Commissioners invite tenders for an electric lighting installation.

France.—Tenders are at present being invited for the supply of four kilometres of paper-insulated double-conductor telephone cable. Tenders to be addressed to the Direction Générale des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

France.—September 10th. Tenders are being invited for the supply of 24,000 copper cylinders and 100 tons of copper wire. Tenders to be directed to the Direction Générale des Postes et des Telegraphes Rue de Grenelle, 103, Paris.

France.—September 16th. Tenders are invited for the supply of a quantity of iron tubes for pneumatic despatch lines. Tenders to the Direction Générale des Postes et Telegraphes, Rue de Grenelle, 103, Paris.

Gravesend.—September 20th. Tenders are invited for the supplying of a telephone, and providing, delivering, and fixing, &c., the necessary poles, wires, instruments, &c., for a line from the sanatorium to the office of the sanitary inspector and the police station, for the town council. Particulars can be obtained of the sanitary inspector, Town Hall.

High Wycombe. — October 14th. The Chepping Wycombe Urban Sanitary authority invite tenders for working the electric lighting provisional order obtained by them within the borough, for a term of years and upon approved conditions. Tenders to be delivered to the Town Clerk, High Wycombe, from whom further details may be obtained.

Holland.—The Dutch Military Authorities are at present inviting tenders for the establishment of a small central station for the electric lighting of the De Ruyter Fort, at Willemstad. Tenders to be addressed to the Café Het Schippershuis, Willemstad, Holland.

London, W.C.—September 10th. Tenders for carrying out the work required in supplying and fixing wires, cables, and fittings for the installation of the electric light at their board room and offices, 57, Broad Street, W.C., for the Guardians of St. Giles and Bloomsbury, have to be in by Tuesday next. Particulars from Mr. James Appleton, clerk.

Oldham.—September 11th. Tenders are wanted for supplying and fixing wires, fittings, &c., for lighting by electricity a portion of the Central Baths, Oldham, for the Baths Committee of the Oldham Corporation. Particulars from Mr. S. Willmott Newington, borough electrical engineer, Gas Street, Oldham.

Queenstown.—September 16th. Tenders are invited for the public and private lighting of Queenstown by electricity according to the report and specification of Mr. Robert Hammond, M.I.E.E., Ormond House, London, for the Queenstown Town Commissioners. Tenders are also invited as follows: The contractor to provide the capital for the due erection of the works and maintenance thereof as per above plans and specifications, on being guaranteed the public lighting, and a stipulated number of private lights (to be agreed upon), the Commissioners having the right to purchase within a specified period. Further particulars and conditions to be had on application to Mr. James Ahern, town clerk, Queenstown.

Rangoon.—November 4th. The Municipal Committee is inviting tenders for electric lighting. Particulars to be obtained from Messrs. Ogilvy, Gillanders & Co., 67, Cornhill, E.C.

Roumania.—October 2nd. The municipal authorities of Braila, Roumania, are inviting tenders until October 2nd next for the concession for (*a*) lighting about 64 kilometres of public streets by both gas and electricity, and (*b*) 64 kilometres of public streets by electricity alone. They are also inviting tenders for the concession for the construction and operation of a network of electric tramways in the principal thoroughfares of the town. Tenders to the Mairc, Hotel de Ville, Braila.

Spain.—Tenders are at present being invited for the supply of 20 tons of sulphate of copper, and 12,000 zinc cylinders for telegraph use. Tenders to be directed to the Direccion Generale de Correos y Telegrafos, Madrid.

Spain. — The Municipal authorities of Jerez de los Caballeros (Badajoz province) are at present inviting tenders for the supply and erection of plant for the electric lighting of the town. Tenders to the Ayuntamiento de Jerez de los Caballeros (Badajoz).

Stafford.—September 14th. Estimates are wanted for wiring and fitting the infirmary for electric light, for the committee of the Staffordshire County Infirmary. Particulars from the engineers, Messrs. Kincaid, Waller, and Manville, 29, Great George Street, London, S.W.

Sunderland.—September 13th. Tenders are wanted for (*a*) High-tension and low-tension concentric cables; (*b*) Cast-iron pipes, and box frames and covers; (*c*) stoneware casing, boxes, and bellmouth protectors; (*d*) high-tension transformers for alternating current; (*e*) Meters for alternating current for the corporation. Further particulars can be obtained from our advertisement pages.

Vienna.—November 14th. The Municipality of Vienna asks for tenders and plans for the construction and working of electric railways in and around the city. The notice may be seen at the Commercial Department of the Foreign Office.

NOTES.

Accumulator Traction.—In the discussion on Mr. Perry's paper at the Londonderry meeting of the Municipal and County Engineers, Mr. E. Pritchard, "of London and Birmingham," stated that the use of electricity and tramway traction by means of accumulators, had been a financial failure. This assertion could only have been made in ignorance of what has been recently accomplished, and we would refer Mr. Pritchard to our recent analysis of the figures relating to the St. Denis (Paris) line for correction thereof.

Institution of Civil Engineers.—The list of subjects upon which this Institution invites papers for the purpose of granting the various awards and premiums which it holds in trust, has been issued. It includes the following and any other questions of professional interest that may occur to authors. We have selected those headings which more directly affect electrical men:—

The Construction, Equipment, and Working of Light or Economical Railways of a permanent character.
The Purification of Sewage by precipitation, filtration, electrolytic, bacteriological and chemical processes.
The Use of Ash-bin Refuse in towns for the production of steam.
The methods of conveying and of using Natural Gas.
The Utilisation of Heat (*a*) generated in the compression of air and other gases; (*b*) carried away by steam engine condenser water; and (*c*) contained in boiler furnace flue gases.
The Methods of Condensing Steam by the use of moderate quantities of water.
The Methods of removing Moisture from Steam, and of reducing losses by radiation from steam pipes.
The Production and Use of Superheated Steam.
The Theory and Development of the Compound Steam Turbine.
The Recent Developments in Gas Engines and Oil Engines, including a comparison of the relative merits of the several Cycles, with reference to "after burning."
The Application of Oil and Gas Engines to tractive purposes on common roads and on tramways, and to the propulsion of vessels.
The Design and Construction of large Turbines.
The Methods of Testing the Lubricating Values of Oils, Greases, &c.
The Comparative Merits of Blast and Reverberatory Furnaces.
The Influence of Carbon on Iron.
The Magnetic Properties of Iron and Steel.
The Extraction of Metals from their Ores by electrolytic processes.
The Methods of Gold mining in California.
The Occurrence, Production and Uses of (*a*) Asbestos, (*b*) Arsenic, and (*c*) Mercury.
Aluminium, its manufacture, properties, uses and alloys.
The most suitable Steam-power Equipments for Electric light stations.
The Utilisation of Electric Lighting Plant during hours of small demand.
The Utilisation of Electrical Energy in the form of heat.
The Regulation of Electric pressure in large lighting circuits as carried out at the engine, the dynamo, or the exciter.
The Theory and Practice of the Transmission of Power by Alternating Currents.
The Use of Electrical Motors for driving machines in textile factories and in engineering workshops.
The first cost, facility and economy of operation of Electrical Traction on Railways with heavy trains, and on Tramways.
The Construction and Working of Electrical Lifts and Cranes.
The Electrolytic Action of Return Currents in Electrical Tramways on gas and water mains, and the best means of providing against Electrical Disturbances.
The Use of Electrical Machinery for lighting and the transmission of power in warships and in the mercantile marine.

The Council desires it to be known that the Institution, as a body, must not be considered responsible either for the statements made, or for the opinions expressed in the Papers or in the consequent Discussions; and it must be understood that such Papers may have Medals and Premiums awarded to them on account of the science, talent or industry displayed in the consideration of the subject, and for the good which may be expected to result from the inquiry; but that such notice or award must not be regarded as an expression of opinion, on the part of the Institution, of the correctness of any of the views entertained by the authors of the Papers.

In the list of premiums awarded during the 1894-95 Session, we observe the following:—

The Manby Premium to Charles Butters and Edgar Smart, A.M.I.C.E., for their joint Paper on "Plant for the Extraction of Gold by the Cyanide Process."
A Crampton Prize to John Richardson (of Lincoln), M.I.C.E., for his memoir, "The Mechanical and Electrical Regulation of Steam Engines."

Electrolytic Corrosion by Tramway Currents.—According to the *Gas World*, the electrolytic corrosive effect of single trolley electric tramway car systems on the gas and water pipes, which has been the cause of so much trouble in the United States, has now begun to cause trouble and anxiety in France. "The dangers involved," says our contemporary, "seem to be quite sufficient to give any gas company a right to object beforehand to the establishment of any system in which current is returned through the soil in which gas pipes are laid. The Supreme Court of Tennessee recently decided that the principle of law governing this matter was that it is not for the companies to protect their mains against the ravages of the electric tramways, but for the latter to abstain from doing damage. This decision was pronounced in an action by a telephone company against an electric tramway company for injury done to its cables by electrolysis due to the earth return currents."

Buffalo Bill and Electric Lighting.—The Buffalo Bill Wild West Show Company, in the States, has this year put down plant for generating its own electricity for illuminating its celebrated show at night. As Buffalo Bill's show has this year no settled destination, but is always on the move, portable plants were necessary, so that they could be easily removed from one place to another. The outcome of the company's deliberations was that two novel duplex plants, of 28 lights each, were designed and built by the Ball Electric Company, and these are now described by a writer in the New York *Electrical Engineer*. Each plant is fitted on a strong waggon. Supported on the wheels by heavy springs are two I-beams with cross bracing, forming the trunk frame. Set below these beams on the rear axle is a burnished steel, copper tube Clapp & Jones fire engine boiler, of the type used by the fire departments of all large cities in the States. To this is piped a 25 horse-power automatic high speed cut-off Case engine, which has proved to be a model of efficiency for this special duty, as it is light and very compact in proportion to its power, as is also the boiler. Connected to the boiler is an injector and a Worthington "Baby" feed pump. All the pump, dynamo, and engine fittings are nickel plated, and the iron work of the truck is heavily japanned and decorated, presenting a very attractive appearance. In front of the boiler on the I-beams is mounted one automatic Ball 28-light 10 ampère series arc dynamo, which is insulated thoroughly from the base or truck, and it is provided with special self-oiling dust proof bearings, &c. This machine is only 53 inches long, 24 inches high, and 20 inches wide, and weighs about 1,500 lbs., being, like the engine, very compact for its capacity. In front of the machine is the switchboard, which is located below the seat. On this are mounted all the electrical instruments necessary for the proper operation of the plant, including a special portable ampèremeter reading up to 20 ampères, two Garton magnetic lightning arresters, a short-circuiting field switch, line terminals, &c. The system of transmission of power between the engine and dynamo is by belting, an endless belt being used in connection with the L. P. and D. transmitter, which seems to be particularly adapted for a portable plant built as compactly as this one is. The weight of each plant complete, with its load of engine, boiler, dynamo, all fittings, coal and water, is about 5½ tons, and this weight is properly supported by springs on special heavy wheels, having 5-inch tyres. Both waggons appear in all street parades, and they create quite a sensation among the electrical and mechanical community wherever seen. They can be easily handled by two horses, although six are generally used for street parade effect. Both these plants have been in nightly operation for the last five months without a mishap or interruption of any kind. They have worked directly exposed to heavy thunderstorms, and in torrents of rain, without the slightest protection from the weather, without the loss of an armature. The reflecting arc globe used in connection with this plant is a combination reflector and globe, and consists of two hemispheres; one of these is blackened on the outside, and corrugated on the inside and silver plated, thus forming a very good reflector. The other half forming the front piece is of clear glass. These globes give an excellent diffusion of the light. The writer, in conclusion sees no reason why such plants should not multiply rapidly, as there appears to be a good field for them among contractors during night operations, and for military purposes.

Electrical Clambake in America.—The seventeenth midsummer clambake of the American Electrical Works was held on August 17th, at Haute Rieve, Providence, R.I. With the friends invited, there was altogether a party of nearly 200 guests, who enjoyed an excellent feast of clambakes, after which toasts in honour of various branches of the electrical industry were replied to by some well-known American electrical men.

In Nubibus.—Smoke prevention and annihilation companies are not having a very prosperous time at present. "Elliott's Patent" Company is no more, and we now learn from the *London Gazette* that "Belcher's patent" Company is also in a state of liquidation, it being found impossible to continue the business by reason of the liabilities.

Electricity in Agricultural Operations.—In February last when announcing the exhibition of agricultural machines to be held at Vienna in May, we ventured to suggest the devotion of a special department to electrical machines used in connection with this industry and its numerous branches. As that exhibition was such a success, the Imperial and Royal Agricultural Society of Vienna has decided to hold a similar show in May, 1896, and we repeat what we then said. For the 1896 exhibition manufacturers will have more opportunity for preparation than was the case with the last, for there are yet about nine months. The prospectus will include not only agricultural machines in the strict sense of the word, but appliances used in all branches of industry connected with agriculture, such as breweries, distilleries, yeast, sugar, vinegar, and starch factories. The mart will also extend to tools and engines used in forestry, sawmills, celluloid factories, orchards, vineyards, in the feeding and breeding of cattle, horses, fish, &c. It will comprise electrical machines in the service of these industries. A collection of specimens of all the machinery used in such a varied list of industries might be called an engineering and general exhibition. It is hardly to be expected that many contractors from this side will have much to do with the show, but if all the various types of electrical machinery used in these trades were brought together they would make a most interesting and instructive collection. Now that so much is being said about agricultural and farming matters in this country, and there seems to be a general attempt to bring about that improvement which is so desirable, it would be a good thing if the advantages of electricity could be brought more to the farmer's assistance. Anyone wishing to make application for space (which will not at present be considered binding) should communicate with the committee of the second International Exhibition of Machines, I Wien, Herrengasse 13, Austria.

Health Precautions in Accumulator Factories.—Although machines have been devised, and are used to a considerable extent for filling accumulator grids, most of the pasting is still done by hand. Hand work is much dearer, but it is most prevalent, because a machine can only deal with one particular size of grid. Now hand labour which involves contact with lead compounds, is attended with great risks to health, owing to the poisonous nature of these materials. Hence means should be consistently adopted to counteract these risks, and the simplest and most effective means of all is cleanliness. Writing in the *Zeits. f. Elektrotechnik u. Elecktrochem*, (1895, p. 412), P. Schoop advises the following precautions for minimising the danger of filling accumulator grids by hand. He would enforce the greatest personal cleanliness amongst the workmen. At meal times, and whenever work stops, the men should be compelled to wash their arms, hands and faces with warm water and soap, and also to change their clothes. The working clothes should be made entirely of wool; they should be brushed and shaken every day when taken off, and should be washed every week. The pasting room should be well ventilated; its floor should be made of asphalte, and should be washed out twice a day. No person who is not sound in health should be employed in the operation of pasting; nor should anyone be kept at it continuously for more than a fortnight at a time, after which he should have a fornight's work out of doors. As the first sign of lead poisoning appears in the digestive organs, the workman losing appetite, and suffering from vomiting, these symptoms should be carefully watched for, and medical advice at once afforded. If the proper precautions are taken, there is no reason why a workman should not enjoy good health, and live a long life, though employed in this dangerous occupation.

Electrical Mishap in France.—Our contemporary, *L'Enérgie Electrique*, in a recent issue, states that recently at an electric lighting station at St. Etienne, a cabin was found to be on fire; the electrician, M. Fargère, tried to put out the fire, and thus placed his hands upon the partition, but could not take them off by reason of the escaping current. A friend seeing what was happening, put his arm round him and pulled him off. Both men fell to the ground. M. Fargère had his hands charred; his friend was injured in the hands and in the right forearm, and his condition is serious.

The History of the Electric Telegraph.—An interesting series of articles has been contributed recently to the *Electrical World* by Franklin L. Pope, concerning the history of the invention of the electro-magnetic telegraph. A large amount of evidence is presented in these articles on behalf of different claimants, and the *Scientific American* says that the author sums up as follows:—

1. The first electro-magnetic apparatus for producing at will audible sounds at a distance was invented, constructed and operated, by Joseph Henry, in Albany, N.Y., in 1831.
2. The first electro-magnetic telegraph for producing at will permanent written marks at a distance was invented by Prof. S. F. B. Morse, in 1832, and constructed and operated by him in New York prior to September 2nd, 1837.
3. The first code of numerical conventional signs capable of being intelligibly written or sounded by the armature of an electro-magnet was originated by Morse in 1832.
4. The first code of alphabetical conventional signs capable of being intelligently written or sounded by the armature of an electro-magnet was originated by Alfred Vail in 1837-38.
5. The relay and combined circuits was invented by Morse prior to September 4th, 1837.
6. The lever key, in its modern form, was invented by Vail in 1844.
7. The dry point recording register was invented by Vail in 1843.
8. The inverted cup of glass for insulating the line wire was invented by Ezra Cornell in 1844-45.

It may be that other documents, in existence and hitherto unknown to historians, may come to light in future years which will materially change the aspect of the question as it appears at the present time, but it has been my desire and intention in what I have here written, in the words of Henry, to render, according to the present evidence, scrupulous and exact justice to all who were concerned in the invention of the electro-magnetic telegraph. The development of this wonderful agency has been from first to last a characteristic and typical example of the great law of evolution, beginning with Henry's apparatus of 1831, and ending, at least until a recent date, with the familiar key and sounder of modern telegraphy. The work of Morse marks only an important and indispensable era in this process of evolution, not its ultimate conclusion, as many writers seem to have somewhat hastily assumed. Yet, in the gradually increasing use of the automatic system of transmission, probably destined to become universal in the future, we may recognise the possibility of a complete reversion to the original scheme of Morse, in which the alphabetical code will be the sole survivor among the contributions of others than himself to the general result.

Association of Edison Illuminating Companies.—The eleventh annual meeting of the sixteenth convention of the Association of Edison Illuminating Companies was held in Detroit, August 13th, 14th and 15th, 1895. The following three companies were admitted:—Edison Light and Power Company, Pottsville, Pa.; the Toledo Electric Company, Toledo, Ohio; the Sault Ste. Marie Company, Sault Ste. Marie. A report by Mr. A. E. Kennelly (for Committee on Lightning Protection, Grounding the Neutral in Three-wire Systems, Cross with High Tension Systems), was accepted and the Committee discharged. Addresses were then made by S. D. Green, Mr. Insull, and Mr. Beggs, on "The Relations of the General Electric Company to Edison Licensee Companies." After considerable discussion, Mr. W. L. R. Emmett, of the General Electric Company, was called upon for a paper entitled, "Some Comparisons between the Direct Current Low Tension System and the Alternating Current and Multiphase System for Central Station Lighting." Mr. Emmett was unavoidably absent, and his paper was ordered to be printed in the minutes. A paper by Messrs. Pierce & Hale was read on "Energy Losses in the Boston Edison Station," also one by Mr. W. S. Barstow on "Method of Charging for Current for Incandescent Lamps and Motors," and Mr. Arthur Williams on "Relation of Company to Customer." There was a discussion on incandescent lamps, Welsbach light and acetelyne gas, followed by a paper by Mr. C. D. Haskins on "Facts in Relation to Mechanical Recording and Chemical Meters."

Prize Competitions.—The *English Mechanic and World of Science* is at present offering six successive prizes of 10 guineas each for the best six short series of illustrated papers on the following subjects:—1. Wood turning for amateurs. 2. Construction of a 1 horse-power oil engine. 3. How to build an harmonium. 4. How to make a small lathe. 5. Metal spinning for amateurs. 6. An oil motor carriage to carry four people.

The Primary Battery Craze.—Yet another revolution in the production of electrical energy, and, once again, by means of the ever-green primary battery. Mr. Levetus, the chairman of the syndicate owning the patents which cover the means of making "a new epoch"—this is a favourite expression in connection with primary batteries—"in the influence of motive power on the life and work of the world," claims that what scientists have asserted as impossible has been accomplished. "They have found a substitute for zinc which only costs one-twentieth of the price." D'Humy, in his never-to-be-forgotten "water" battery employed iron, but the new material must be something cheaper even than iron. "By an automatic circulatory device they do away entirely with polarisation." Automatic circulatory arrangements for keeping the fluid in motion are legion, but how, in the name of all that is wonderful, can a galvanic couple be produced in which there is no polarisation? Polarisation is part and parcel of all galvanic elements, but the effects of polarisation can be almost wholly removed or neutralised for the time being by well-known methods. By the new invention, it is asserted that the Board of Trade unit can be produced for 6d., and a horse-power hour for 4d. Even assuming that this statement of cost possessed a modicum of truth, the dynamo still beats the primary battery hollow, and secondary batteries, with the losses entailed by their use, would still be more economical than the "horse that only costs 4d. per hour, and eats no corn." Remembering the Walker-Wilkins boom, the Clydebank youths who claimed even better results at the beginning of the year than does Mr. Levetus and his following, we would warn the non-technical press against the insertion of such arrant nonsense as that contained, for example, in the leading article of the *Sheffield and Rotherham Independent* of last Wednesday. It is simply a repetition of the twaddle which formed "matter" for the columns of numberless newspapers concerning the above-mentioned "inventions," which seem to have had their brief day. To the shareholders in the syndicate who were so warmly congratulated on having made a splendid speculation, we can only offer our sympathy; the speculation *is* splendid, but the result of that speculation will, we fear in the end, only bring remorse. Any of our readers who have seen this battery, or know the secret of its construction, will be doing the general public a service by sending us all the information at their command.

Obituary.—We regret to have to announce the death, on August 30th, of Mr. H. C. Hart, one of the first class technical officers of the engineer-in-chief's office, Post Office Telegraphs. Mr. Hart joined the telegraph department in June, 1870, shortly after the transfer of the companies' business to the state. He has throughout his official career taken a keen interest in the great developments of the telegraph and telephone industries and in Post Office work generally. He was a director of several of the mutual associations started and managed by Post Office men for the benefit of their brother officers. His loss will be deeply deplored by all with whom he was brought into contact. The interment took place on Monday, the 2nd inst., at Elmer's End Cemetery. Among those present to render a last tribute of respect to their late colleague were Mr. J. Hookey, assistant engineer-in-chief, Messrs. J. B. Chapman, T. H. Stockwell, P. Ennis, J. W. Curra, R. C. Leversedge, T. Reid, and J. Ward, of the engineer-in-chief's office, and many representatives of other branches of the Post Office. The deceased gentleman was 49 years of age.

The American Society of Mechanical Engineers is at present mourning the loss of its president, Mr. E. F. C. Davis. The society has passed resolutions recording its sympathy with the relatives of the deceased gentlemen.

Electric Railway Accident in America.—A telegram from New York says that an accident occurred on 3rd inst. in connection with the electric railway at Seneca Falls, New York State. An employé at the generating station accidentally received the full current at his wrists at 1,700 volts. He was hurled some distance, and was believed to be dead. The doctors succeeded, however, in restoring him to consciousness, and he was able to resume work later in the day.

A New Field for Electricity.—In a recent article under this heading, the *Electrical Age* considers it high time the U.S. naval authorities set about to discover some better method of protecting the bottoms of vessels from corrosion and fouling. It thinks a saving of millions of money might be effected in the annual expenditure on war vessels, as well as higher speeds attained by their freedom from corrosive and fouling substances, by attention in this direction alone. After citing instances of the loss of speed and great expense consequent upon this evil, our contemporary repeats that greater effort should be put forth to encourage some practical and safe remedy, and says, in conclusion, that it is now claimed that a Kentuckian has at last discovered that, by the use of certain compounded ingredients in connection with electrical treatment, that a body has been created that stands, and is proof against the action of sea-water and against corrosion and fouling. It is believed that docking will be unnecessary after a vessel has been once properly prepared and launched, as the hull will be kept clean electrically. The enamel has been submitted to a test with most satisfactory results which have so far exceeded expectations, and the belief is that this system is destined to play an important part in the economy of our merchant marine and new men-of-war of the future. Let us hope something tangible has been discovered by the Kentuckian, but there is no reason why his researches should hinder investigators on this side working vigorously in this direction.

Lightning and Barns.—Mr. McAdie's pamphlet on "Protection from Lightning" has been revised and republished. Among the additions made to the old material is a discussion of the question whether barns are any more liable to be struck by lightning after being filled than before. The *Scientific American* says that Mr. McAdie cites these figures: Last year prior to August 1st, 223 persons were reported as killed by lightning in the States; after that date, 113; dwellings struck, before August 1st, 173; after, 87; churches, before, 10; after, 15; barns, before, 130; after, 138. It thus appears that while much more than half the year's damage done by lightning in other directions occurred prior to the date mentioned, a trifle more than half the injury to barns from that cause came afterward. Mr. McAdie mentions three possible reasons for this increased peril after harvesting the crops: (1) The stalks of grass and growing grain serve as tiny lightning rods, and relieve the electric strain between sky and earth, but when they have been cut down only the buildings and trees are left to serve that purpose; (2) a full barn is warmer, and hence more readily ignited than an empty one; and (3) the vapour in the warm air, rising from a barn filled with new hay, attracts the electric current and invites a discharge by that route.

Pearson's Young Man Again.—A representative of *Pearson's Weekly* has been interviewing a publican—evidently a wicked sinner to boot—and has, like Dagonet, been spoofed. One of the dodges for robbing public houses, says this young man, is a telescopic walking stick, which will lengthen out to about 10 feet. Attached to the end is a small *magnet*, which picks up gold and silver coins. Notwithstanding the progress of civilisation, and the spread of technical education, a steel magnet has not yet been taught to form any improper attachment to gold or silver. It is the irony of fate that Pearson's young man should go wrong on electrical or magnetic lines.

Electricity in Dentistry.—Before one of the recent annual meetings of the British Dental Association at Edinburgh, Messrs. H. B. Izard and W. Bryson, Edinburgh, gave a lecture and demonstration on "Electricity in Dentistry." The lecturers showed primary batteries, storage batteries, gas engine and dynamo for charging cells, gas engine and dynamo for giving the current direct, street supply, motors, mallets, lamps, resistances, water heaters, and samples of all the present applications of electricity to dental work.

Marriage.—Mr. Robert Hope-Jones, of electric organ fame, has our hearty good wishes on his marriage to Miss Laurence, of Hollingbourne, which occurred on 27th ult., at Leeds Parish Church.

The Paris Exhibition of 1900.—The ambition evinced by Frenchmen to outdo the Chicago Exhibition of 1893 by an immense and unprecedented show in the year 1900 does not appear to be so heated as it was, at any rate this is so in certain quarters. It has even been said that if a member of the Chamber of Deputies were to have courage enough to oppose the granting of government subsidies for the Exhibition there would be a great following on the part of other members. Whatever of truth there may be in these rumours, the arrangements for the show which is to be held five years hence are taking form. There are and will be of course various and extensive proposals regarding the part which electricity is to play. A project has been presented by M. Picard proposing the construction of a "Palais de l'Electricité" at the Champ de Mars. The palace at night would be resplendent with beautiful illuminations, electricity, of course, playing the principal part. A short electric railway would make a circuit of the chief esplanades. In the estimate of expenses for his project mechanical and electrical, services require a provision of nearly seven million francs.

Electric Lighting at the Battersea Polytechnic.—According to *Transport*, the electric lighting installation at the Battersea Polytechnic shows economy as compared with gas. There is a complete installation on the premises designed for 1,100 lights in various parts of the building. There are two dynamos and a 12-H.P. gas engine, and they reckon that their glow lamps cost them at a rate equivalent to only 1s. 9d. per 1,000 feet of gas. "We believe it was anticipated that by running their own electric light a saving of 8 per cent. would be made, but they have achieved a good deal more than that—if they have not made a mistake by leaving some of the items of expense out."

Railways for Abroad.—Last Saturday's daily papers had two important notes regarding the construction of railways for Russia and Chili. We have already stated that the Tsar is very favourably disposed towards electric railways, and we now learn that at the forthcoming National Exhibition at Nijni-Novgorod admission will exceptionally be granted to articles of foreign manufacture connected with the construction of narrow-gauge railways for the purposes of local traffic. There ought to be an opportunity for some electric railway business here. Regarding Chili, the *Financial News* gave the text of the Bill which has been partly passed by Chilian deputies for the encouragement of railway construction in Chili.

Business References.—We have our reasons for believing that the present is a fitting time to reiterate our oft-repeated warning to electrical firms to demand references before supplying goods to new customers. We have within the last few days had an instance brought to our attention of a London firm which has been deceived through allowing a parcel of goods to be delivered to a new customer before such references had been received. When the matter was inquired into the supposed *bonâ fide* customer was found to have decamped with the goods, leaving the office rent unpaid. Our readers need no further warning; caution should be exercised in opening new accounts with either home or foreign houses.

Are they Electrical?—"Dogberry," writing in Wednesday's *City Press* regarding horseless carriages, says:

> I believe that the electric cars at Brixton are a decided success, though I am ashamed to say I have not tried them yet. Whether by steam or electricity, there is absolutely no reason that I know of why all the tramcars, at least, in the metropolis should not be run without horses, and I hope they will be.

We hope so, too, but may we ask the writer what part of Brixton these electric cars are running? One of us, at least, has occasion to go in that direction every day, but we have not yet heard of the electric tramways there.

Correspondence.—We have received, too late for insertion in this week's issue, a letter from Captain Benest on "Coast Communication," also one from Mr. Weekes on "Iron Losses in Transformers."

Artificial Respiration.—Dr. Mount Bleyer, of New York, has contrived an apparatus for artificial respiration, employing compressed air or oxygen for the purpose, and forcing it into the lungs through tubes passed into the throat. His description (*Electrical Review* of New York, August 21st, 1895), does not clearly explain his method. We may hope that his apparatus will prove of service, but we should like to have had more precise details of its mode of working. The idea, as we have said before, is a good one.

Slide Rules.—In answer to a correspondent, we strongly recommend the large Fuller rule. It is manufactured by Stanley, Great Turnstile, Holborn, W.C., and full instructions are given with it.

NEW COMPANY REGISTERED.

Portable Electric Lamp Company, Limited (45,052).—This company was registered on August 26th with a capital of £50,000 in £1 shares, to acquire patent No. 9,826, of 1894, for "improvements in portable primary batteries" and other patent rights, and to manufacture, sell, and deal in steam, gas, and other engines, dynamos, cables, wires, batteries, motors, lamps, &c. The subscribers (with one share each) are:—E. L. Walmsley, 30, Appach Road, Brixton, clerk; F. H. Sanders, 30, Appach Road, Brixton, clerk; E. F. Grainge, Broad Street House, E.C., gentleman; R. G. Taylor, Trafalgar Buildings, Charing Cross, gentleman; A. M. Forbes, 85, Gracechurch Street, E.C., clerk; L. White, 30, Lime Street, E.C., gentleman; J. Seagrave, 5, Park Villas, Blackheath, agent. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 250 shares; remuneration, £350 per annum, and a share in the profits divisible. Registered by W. T. Moore, 24, Budge Row, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Pearson's Automatic Fire Indicator Company, Limited (43,233).—This company's statutory return was filed on July 31st; 1,715 shares have been taken up out of a capital of £5,000, in £1 shares, and 1,000 have been issued as paid, 10s. per share has been called on 708, and nothing on seven, and £354 has been paid.

New Electricity Supply Company of Croydon, Limited (37,150).—This company's return for 1894 has just been filed; 29 shares have been taken up out of a capital of £40,000, in £5 shares, and the full amount has been called and paid.

Reading Electric Supply Company, Limited (35,651).—This company's annual return was filed on July 9th. The capital is £75,000, in £5 shares, and 2,819 have been taken up. The full amount has been called and paid.

Ecuador Telephone Company, Limited (29,295).—This company's annual return was filed on July 12th. 5,000 shares have been taken up out of a capital of £100,000, in £5 shares, and the full amount has been called and paid.

Electric Guest Call Company, Limited.—The statutory return of this company was filed on June 27th. The capital is £5,000, in £1 shares (1,500 "A" and 3,500 "B" shares). All of the "B" have been issued as fully paid, while 1,062 "A" shares have had the full amount called. £980 has been paid, leaving £82 in arrears.

English Electric Carbon Company, Limited (38,434).—This company's annual return was filed on July 1st, when 789 shares were taken up out of a capital of £10,000, in £10 shares. £7,840 has been paid, leaving £50 to be paid.

Rand Central Electric Works, Limited (43,712).—This company's statutory return was filed on August 21st. The capital is £300,000, in £1 shares, and 275,000 have been taken up. 5s. per share has been called, and £68,750 paid.

Gorseinon Electric Light Company, Limited (39,944).—This company's annual return was filed on June 1st, 926 shares have been taken up out of a capital of £1,000 in £1 shares, and 15s. per share has been called. £578 5s. has been paid, leaving £16 5s. in arrears.

London and Hampstead Battery Company, Limited (36,425).—This company's annual return was filed on July 31st. The capital is £50,000 in £5 shares (7,000 preferred and 3,000 deferred); 993 preferred have been taken up and paid for in full, while the deferred shares have been issued as fully paid.

CITY NOTES.

Brighton and Rottingdean Seashore Electric Tramroad Company, Limited.

A meeting of the shareholders was held on Friday, the 30th ult., at the office, Madeira Road, Brighton.

The Chairman (Mr. E. O. Bleackley) who presided, said the formal business was to authorise the issue of debentures when the directors should consider it desirable. His first duty to the shareholders was to explain why the line would not be opened this season, as they had confidently anticipated it would be when they last met there. As usual, the cause of the delay was the Corporation of Brighton, in which body unfortunately there was a strong party who had done everything in their power from the very outset to damage and thwart the undertaking and delay its completion in every way. After reading a letter from the town clerk, notifying that the corporation were about to construct a groyne extending much farther southward than the present one, the chairman explained that an alteration had to be made in their line in order to go over the groyne, but that was subject to the approval of the Board of Trade, which had not yet been received. Had they been able to continue at work throughout the summer the line would have been quite completed by the present time. As it was they would be ready for traffic by the beginning of next summer.

A resolution, authorising the directors to raise £5,000, was agreed to.

The Electric Construction Company, Limited.

The report of the directors which is to be submitted to the shareholders at the second annual general meeting, to be held on Thursday next, 12th inst., at Winchester House, E.C., at 2.30 p.m., states that the accounts for the year ending June 30th, 1895, submitted herewith, show a gross profit of £46,690 15s. 2d., including £2,260 5s. 7d. brought forward from last year. Deducting from this amount interest, outlays on maintenance of buildings, plant, and patents, general expenses, and £5,000 for depreciation, the result is a net profit of £12,091 10s. 3d., whereof the directors recommend that £1,956 14s. 5d. be applied in payment of the dividend of 7 per cent. on the preference shares, and the balance of £10,134 15s. 10d. carried forward to the credit of next account. The profit and loss account shows a considerable reduction of general expenditure, and, notwithstanding the keen competition prevalent, a substantial increase of manufacturing profit. Several important electrical installations have been successfully completed during the year, the production at Bushbury has increased, and the quality of the machinery and plant manufactured has been fully maintained. The directors have pleasure in reporting that the works are fully employed on orders, at prices somewhat in advance of those obtainable last year, that the plant and number of the workmen have been increased, and that they are well satisfied with the efficiency and zeal of the staff and employés of the company. Among the works in progress may be mentioned the important electric lighting installation at Clerkenwell, and the electrical equipment of the Hartlepool tramways. It is confidently expected that the substitution at Hartlepool of electric traction for the steam-power formerly used, will prove that tramways heretofore worked by horse or steam-power unremuneratively, may be judiciously adapted for electric traction, and yield a satisfactory return on the necessary outlay. Such a result cannot fail to give a great impetus to the development of electric traction in various directions. The directors who retire by rotation at the general meeting are Messrs. James W. Barclay and J. Irving Courtenay. They are eligible for re-election. Messrs. James Meston and Co., the auditors for the past year, offer themselves for re-election.

Profit and Loss Account for year ending June 30th, 1895.

	£	s.	d.
To Interest on loans and debentures paid and accrued	13,223	17	5
„ General charges—Salaries to staff in head office and works, £8,149 19s. 4d.; rent, rates and taxes at head office and works, £1,043 18s. 4d.; insurances, £195 3s. 10d.; advertising, £800 10s. 10d. travelling expenses, £721 7s. 2d.; patent fees and royalties, £483 4s. 2d.; law charges, £101 11s. 9d.; printing and stationery, postages and telegrams, £651 7s. 4d.; commissions and agency charges, £130 1s. 6d.; general expenses, bank charges, stamps, &c., £889 0s. 9d.; fees and expenses of trustees under first and second mortgages, £210 5s. 6d.; auditors' fees, £120; directors' fees, £1,500 ... ... =	14,996	10	5
„ Maintenance of plant and buildings, £1,378 17s. 1d.; depreciation account, £5,000 ... =	6,378	17	1
	34,599	4	11
„ Net profit	12,091	10	3
	£46,690	15	2
By Amount brought forward from last year	2,260	5	7
„ Gross profit, viz :—On manufacturing and contracting, £31,814 12s. 7d.; rents, profit on maintenance contracts, premiums from pupils, and sundry profits, £6,701 4s 10d.; interest and dividends on debentures and shares of other companies, £5,890 13s. 8d.; transfer and registration fees, £23 18s. 6d. ... ... =	44,430	9	7
	£46,690	15	2

Balance Sheet, June 30th, 1895.

Capital and Liabilities.	£	s.	d.
Capital authorised—150,000 ordinary shares of £2 each, £300,000; 50,000 cumulative 7 per cent. preference shares of £2 each, £100,000... ... =	400,000	0	0
Capital issued—1.0,000 ordinary shares of £2 each, fully paid, £220,000; 13,145 cumulative 7 per cent. preference shares of £2 each, fully paid, £26,290; 3,198 cumulative 7 per cent. preference shares, £1 10s. paid up, £4,797; add calls prepaid, £744 10s. = £5,541 10s.; less calls in arrear, £68 5s. = £5,473 5s. ... ... =	251,763	5	0
Debentures issued—First mortgage 6 per cent. debenture bonds, authorised issue, £150,000, £125,400; (246 first mortgage 6 per cent. debenture bonds, issued and deposited as security, £24,600); second mortgage 6 per cent. debenture bonds, authorised issue £100,000, current at July 1st, 1894, £46,900; less drawn and paid off during year, £2,210 = £44,690 ... ... =	170,090	0	0
Loans (secured by deposit of £24,600 first mortgage debentures, and of shares and debentures in other companies)	110,000	0	0
Creditors—Sundry creditors, £20,136 7s. 7d.; debenture interest accrued, £4,850 8s. 6d....	24,986	16	1
Bills payable	1,164	12	5
Depreciation account — Brought forward, £3,000; credited for year, 1894-5, £5,000 ... ... =	8,000	0	0
Profit and loss account—Net profit	12,091	10	3
	£578,096	3	9

Assets.	£	s.	d.
Properties, Patents, and Goodwill—Freehold and leasehold land and buildings at Bushbury (Wolverhampton) and Millwall; plant, machinery, tools and patterns at works; patents and goodwill, as per last account, £304,386 15s.; additions to plant and furniture during the year, £1,725 2s. 8d.; additions to buildings, £214 19s. 10d. = £306,326 17s. 6d.; less property at Commercial Road, Wolverhampton —sold, £2,351 1s. 11d. ... ... =	303,975	15	7
*Shares and debentures of other companies	135,670	9	10
Sundry debtors (after providing for bad and doubtful debts)	86,464	3	1
Trustees of first mortgage debentures—price of property sold	2,500	0	0
Bills receivable	304	1	0
Work and contracts in progress—cost	18,134	4	7
Stock—finished goods and materials on hand—cost	22,670	15	6
Cash at bankers and in hand	8,376	14	2
	£578,096	3	9

* Note.—There is a contingent liability in respect of amounts uncalled on certain of these shares.

We have examined the foregoing balance-sheet and profit and loss account, with the books of the company, and are of opinion that they exhibit a true and correct view of the state of the company's affairs.

James Meston & Co.,
Chartered Accountants.

85, London Wall, E.C., *August 26th*, 1895.

The Hove Electric Lighting Company, Limited.—This company is inviting applications for the unallotted portion of the company's shares and 4½ per cent. debentures. The £5 shares are offered at £5 5s. each, and the debentures at the price of £103 per £100 debenture.

Commercial Cable Company, Limited.—The directors have declared a quarterly dividend of 1¾ per cent.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending September 1st, 1895, amounted to £786; week ending September 2nd, 1894, £794; decrease, £8; total receipts for half-year, 1895, £7,669; corresponding period, 1894, £7,735; decrease, £66.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of August, 1895, amounted to £1,957, against £1,583 in the corresponding period of last year.

The Liverpool Overhead Railway Company. The receipts of this railwa for the week ending September 1st, 1895, amounted to £1,272; correspond ing week last year, £1,152; increase, £120.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 30th, 1895, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,088.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, August 28th.	Closing Quotation Sept. 4th.	Business done during week ended Sept. 4th, 1895. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	4 %	4 %	102 —105	102 —105	...	...
1,912,880£	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	£2 2s.	47 — 49	48 — 50	...	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	£4 4s.	89 — 90	89 — 90	90	89⅛
2,993,560£	Do. do. Defd.	Stock	...	...	...	8¼— 9	8⅜— 9¼	8½	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6¼% §	6¼% §	...	13⅜— 14¼	13⅜— 14¼	14 1/16	13⅞
75,000£	Do. do. 5 %, Debs., 2nd series, 1906 ...	100	5 %	5 %	...	111 —115	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	10%‖ §	... §	2½%	3 — 3½	3 — 3½xd	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —165	160 —165	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	2 % §	1½%	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	13 — 14	13 — 14 xd	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20 — 21	20 — 21 xd	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9⅜— 10¼	9⅜— 10¼	...	...
30,000£	Do. do. 4½ % Debs Nos. 1 to 6,000 ...	50	...	...	4½%	103 —106 %	103 —106	...	...
60,710	Direct United States Cable, Ltd.	20	3½% §	2⅜% §	2 %	9 — 9½	9 — 9½xd	9¼	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	6½%	17 — 17½	17⅛— 17⅜	17¼	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 % §	6 %	17¾— 18¼	17⅜— 18¼	17⅞	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	105 —108	105 —108	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	127 —130	127 —130	128½	128
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17⅝— 17⅞	17¾— 18	17 1/16	17⅜
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	102 —106 xd	102 —106	105½	104½
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	103 —106	103 —106	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —128	126 —129 xd	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	102 —106	102 —106	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	103 —106	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	105 —108	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	113 —116	113 —116	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅜% §	4⅜% §	4⅛%	10⅛— 10⅜	10⅛— 10⅜	10⅜	10⅛
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 %	16½— 17⅛	16½— 17⅛	17⅛	16¾
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜% §	8⅜%	8⅜%	21⅜— 22¼	21⅜— 22¼	22¼	22
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	105 —108	103 —106 xd	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	50 — 53	50 — 53	52	50½
37,548	London Platino-Brazilian Teleg., Ltd.	10	2 %	2½%	1½%	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	6 %	6 %	6 %	107 —111	104 —108 xd	...	...
28,000	Monte Video Teleph. Co., 6% Pref., 1 to 28,000	5	*nil*	4 %	...	1½— 2½	1½— 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 % §	5 %	6 — 6¼	6 — 6¼	6¼	6 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17	16½
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 16	15 — 16	15⅝	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6¼	6 — 6¼	6 1/16	6⅛
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	106 —108	106 —108	106½	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	4¼%	9/16— 11/16	9/16— 11/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	107 —110	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	*nil*	3½— 4½	3½— 4½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	127 —132	127 —132	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	2½— 3	2⅜— 3¼	2 1/16	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	92 — 97	92 — 97	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	...	*nil*	5½ — 6½	5½ — 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	103 —106	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½— 2½	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	99 —104	99 —104	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	2½%	3 %	10½— 10⅝	10½— 10⅝	10 7/16	10⅜
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½— 7	6½— 7	...	...
33,129	Do. do. do. Def. Ord.	7½	...	...	1 %	4¼— 4⅜	4¼— 4⅜	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	101 —105	101 —105	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	101 —105	101 —105	...	...
88,321	West India and Panama Teleg., Ltd.	10	½%	⅞%	1%	⅜— 1	¾— 1	⅞	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 10½	10 — 10½	10 7/16	10 5/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8½— 9½	8½— 9½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	110 —113	110 —113	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	113 —118	113 —118	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	102 —104	100 —103xd	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½%	4½%	5¼— 5⅜	5¼— 5⅜	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	...	...	...	6⅜— 7½	6⅞— 7½	7	6 13/16
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	...	116—118	116 —118	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	5 %	14½— 15½	15 — 15½	15½	15⅛
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	15½— 16½	16⅛	15⅝
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —134	132 —135	135	133½
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8½— 9¼	8½— 9½	...	...
10,000	Do. do. do. 6% Pref., £4 pd., 40,001—50,000	10	...	...	...	6¾— 7½	6⅞— 7½	7½	7
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	5½%	7⅞— 8½	7⅞— 8½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2½%	3 %	11½ — 12½	12 — 12½	12⅝	12
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	117 —119	117 —119	117	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	1 %	8½— 9	8½— 9½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	4½%	6½%	8¾— 8⅞	8¾— 8⅞	8⅞	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9½	9⅜
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	5 %	8¼— 9	8¼— 9	...	...
8,000	Do. do. do. Ord., 60,001 to 68,000 ...	5	...	...	...	8¼— 8⅝	8¼— 9	...	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Aug 28th.	Closing Quotation, Sept. 4th.	Business done during week ended Sept. 4th, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	6 % §	6 % §	...	2 — 2¼	1⅞— 2⅛	2	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	6 % §	...	2 — 2¼	1⅞— 2⅛	2¼	2 1/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	113 —116	111 —114	...	...
630,000*l*	City and South London Railway	Stock	⅝%	⅝%	1¼%	38 — 40	38 — 40	39½	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	...	1 — 2	1 — 2	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	...	...	5 %	2 — 2½xd	2 — 2½xd	...	...
100,000	Do. do. do. 4½% Deb. Stock Red....	Stock	...	...	4½%	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	*nil*	⅝— ⅞	⅝— ⅞	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2 — 2½	2 — 2½	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	¾— 1	¾ — 1	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅞— 1⅛	⅞ — 1⅛	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	¼— ⅜	¼— ⅜	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	*nil*	...	6½— 7½	6½— 7½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	6 %	10½— 11½	11¼— 11⅝	...	...
3,000	Do. do. do. 7% Pref.	10	...	...	...	15 — 15½	15 — 15½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	...	106 —109	104 —107 xd	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	10 %	19 — 21	19 — 21	20	...
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	1½%	10⅞ — 11	11 —11⅛	11 1/16	...
10,000	† Do. do. Pref., £10 paid	10	...	5 %	5 %	15 — 15½	15 — 15½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	20 %	43 — 45	43 — 45	44½	43½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	4⅜— 4⅝	4½— 4¾	4⅝	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅞—6¼.

Electric Construction Corporation, 6 % Debentures, 95—100.

House-to-House Company (£5 paid), 4—4¼.

Do. do. 7 % Preference, of £5, 8—8¼.

Do. do. 4½% Debentures of £100, 110—112.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 7⅞—8¼; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.

Liverpool Electric Supply, £5 (fully paid), 7¼—7⅞.

London Electric Supply Corporation, £5 Ordinary, ⅜—½.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 5⅞—6¼.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

RAILWAY SPEEDS.

The final racing to Aberdeen by the East and West Coast routes appears to have finished off by a final effort on the part of the West Coast with a train of 68 tons only, and the run of 540 miles was in this manner made in 512 minutes, a truly excellent performance, but nevertheless showing clearly that the limit of speed had been attained for the train loads, and that greater speeds must be attended by less paying loads. American practice pointed to the ratio of 1 : 2 as between the locomotive and the total load, and though the recent racing has left the American work considerably behind, the highest records are approaching the same ratio of train load. The one notable feature is the performance of the single driver locomotives, the moderate maximum speed over any special section, and the high minimum speeds to which and short stoppages, the high average is due. It has been plainly demonstrated that punctuality can be attained, and that the lack of it, in the southern counties more particularly, is due to incompetence in management, and the filtration downwards through all ranks of an utter carelessness and callousness. So far as regards electrical traction, we may, perhaps, be able to learn, when all the figures come out, just what effort is necessary to draw a given load at these high speeds, though we cannot learn whether any special efforts have been made to secure records of the indicated horse-power developed, or of the pull of the drawbar. In this respect steam locomotion is wofully deficient in ascertained facts. A dynagraph car does not, we believe, exist in England, though numerous tests have been made in America and in France. Information is badly needed on the subject of train resistances. That these are less than has been thought for high speeds is pretty certain, but how much of the gross resistance is due to the locomotive and how much to the train is as yet doubtful. Probably the indicated horse-power of a locomotive at maximum speed, with a train of 100 tons, will not fall short of, or much exceed, 1,000, and if half of this is consumed in front of the drawbar, it may be assumed that in electrical work the avoidance of a *locomotive*, and the use of motor cars, should save half the power at high speeds as compared with steam traction. If, as so freely prophesied, electrical traction is adopted for main line through traffic, and a sufficient traffic could be secured to make it pay, there need be no stoppage between London and Aberdeen. We do not ourselves look forward to this day, but rather to the many other openings for electrical working which, if properly filled, would find work for many a day yet to come. Indeed, main line traffic may well be left to the care of the future. There is enough work in view to tax all resources for the present.

THE CITY AND GUILDS EXAMINATIONS.

The results of the May examinations held by the City and Guilds of London Institute have now been published, and the programme for the coming session issued. Students are deeply interested in the personality of the examiners appointed by the Institute, as upon the selection made the class of questions to which prominence is given very largely depends. We have witnessed a gradual improvement in the style of the papers and in their scope; this upward tendency is being continued, and, as will be seen from the following remarks, the requirements are being brought more and more

in touch with practice. It is a pleasure to be able to note from the programme that in the next examinations in electric lighting, special weight will be given to alternating current work. This is, no doubt, due to the new examiner, whose influence can do nothing but good. There is no consultative examiner in telegraphy, but in electric lighting, Dr. J. A. Fleming holds that post, a similar position being held by Dr. Gore in electro-metallurgy. In mechanical engineering, the consultants are Prof. A. B. W. Kennedy, Prof. R. H. Smith, and Prof. Hele Shaw. It would be difficult to find anywhere in the United Kingdom a better or more competent triumvirate. It is even more important that the acting examiners should be men of good standing, and no fault can be found with the following :—For telegraphy and telephony, Mr. H. R. Kempe; for electric lighting and distribution of power, Prof. S. P. Thompson and Mr. James Swinburne; for electro-metallurgy, Mr. J. T. Sprague; and for mechanical engineering, Prof. Hudson Beare and Prof. J. Lyon.

Among the modifications introduced in this programme is the addition of a subject, "Painters' and Decorators' Work," the creation of a preliminary examination in plumbers' work, and of a practical examination for electric wiremen. Wiremen who are candidates for the certificate in the wiremen's examination will be required to pass the preliminary examination, and then will be eligible to proceed to this practical examination to be held, at some date to be hereafter fixed, later in the summer. The preliminary examination was instituted with the view of bridging over the interval between the ordinary school teaching and the special technical instruction of lads who are being trained to enter one of the electrical trades; the syllabus of instruction being very elementary, it was not thought advisable that the Institute should give any certificate in connection with this examination. Considering the ridiculously easy questions asked, we quite approve of this manner of dealing with beginners, who are thereby incited to proceed to further courses, and when they have gained some really useful knowledge, can take the coveted certificate.

The classes recognised by the Institute are only those that have been "registered" as giving instruction according to their syllabus in specific subjects. In order that a class may be registered, it must be managed by a responsible committee, which is required to submit to the Institute the qualifications of the teacher or teachers for approval. Persons possessing the Institute's full technological certificate in the honours grade of any subject are at once recognised as qualified to give instruction in that subject. Other persons must be selected in the first instance by a local committee, and afterwards approved by the Institute. In many cases the refusal of the Institute to recognise a teacher has led to the appointment of a more competent instructor, and the fact that in most cases the selected teacher is required to present himself for the honours examination, in order that his name may be retained on the register, tends to raise the standard of instruction. Notwithstanding the care exercised in the registration of teachers, it is evident that in many subjects the standard of instruction is still at a low level, and the want is very generally felt of competent teachers familiar with practical work, who have received an adequate training in the methods of instruction, and in the principles and applications of science, and who, at the same time, have the leisure and inclination to conduct classes for the small remuneration usually offered. We are aware of the fact that the only way in which a teacher can command a good salary, is to first show his capability by obtaining really good results at the previous year's examination. There are now 53 registered teachers in electric lighting, and no less than 60 in telegraphy; but a large proportion of these are not actually engaged in teaching work. As Mr. Fletcher has said in the preface to his work on "The Steam Jacket," lamenting the dearth of really useful engineering books, "Our cleverest engineers, and those most competent to write good practical books which would be of permanent value to the rising generation of engineers, are so busily engaged in the manufacture of engines, that they have not the time to write about them, for the very reason that the manufacture of engines is a far more profitable undertaking than the production of books relating to engines." A similar remark would apply to the position of really competent electrical engineers with regard to technical teaching; no central station or manufacturing electrical man can spare the time necessary to deliver more than one lecture a week, and to prepare his matter and correct the necessary exercises without his legitimate work suffering in consequence.

The syllabus of telegraphy and telephony has been left very much as it was. We think, however, that the questions, in the ordinary grade of this subject more especially, might be with advantage a little more nearly related to telegraphic work, and less general in character. For example, out of the 16 questions set in the ordinary grade last May, only four are telegraphic in character, the others might equally well have been given in the Science and Art Department's "Electricity and Magnetism" examination. This objection applies with less force to the Honours papers, which, as some of our readers are aware, are separated, individual papers being provided on telegraphy and on telephony. In electric lighting there are now no less than six different papers, the preliminary written and the preliminary practical, the ordinary, and the honours in three sections :—A, Electrical Instruments; B, Dynamo Manufacture; and C, Central Station Working. It is a sign of the times that alternating currents should now have special stress laid upon them. The preliminary paper last given was certainly rather stiff for the class of examinees for whom it was prepared, and some of the questions could hardly be claimed to fall within the syllabus of the Institute. The ordinary paper was just about right, and the Honours were comparatively easy.

No little interest centres on the results of such examinations. We have extracted and collated the names and centres of the prize winners in the principal engineering subjects. It will be noted that no first Honours medal was given for the electrical instrument sub-section; at least, we have failed to find any such mention in the prize list. A second table gives the medals awarded to each of the successful centres, and the most encouraging sign is the good position taken up by many of the smaller polytechnics and technical schools. None come near Manchester Technical School in point of quality or quantity—25 medals is a remarkable result. Another curious thing is, that many of our leading and most expensively equipped colleges have fared badly; evidently equipment and prestige are not earnests of success.

Prize Winners.

Telegraphy and Telephony (Ordinary Grade).

1st and silver medal, £2, W. A. Stevens, Maidstone Science School.
2nd and bronze medal, £2, T. Mears, Wigan Mining School.
3rd and bronze medal, £1, W. H. Winny, London.

Telegraphy (Honours Grade).

1st and silver medal, £3, C. H. Yeaman, Croydon.
2nd and bronze medal, £3, C. Whillis, Durham College of Science.

Telephony (Honours Grade).

1st and silver medal, £3, T. Plummer, Cork.
2nd and bronze medal, £3, H. Jackson, Heanor Technical School.

Electric Lighting (Ordinary Grade).

1st and silver medal, £2, H. L. Mills, Croydon Polytechnic.
2nd and bronze medal, £2, A. N. Rye, Finsbury Technical College.
3rd and bronze medal, £1, C. H. Naylor, Yorkshire College, Leeds.

Electric Lighting (Honours Grade, I.).

1st and silver medal, £3. None granted.
2nd and bronze medal, £3, C. E. Raeburn, Glasgow Technical College.

Electric Lighting (Honours Grade II.).

1st and silver medal, £3, R. S. McLeod, Manchester Technical School.
2nd and bronze medal, £3, S. Richardson, Paget's Factory, Loughborough.

Electric Lighting (Honours Grade III.).

1st and silver medal, £3, E. D. Phillips, Bolton Technical School.
2nd and bronze medal, £3, C. A. L. Prüsmann, Manchester Technical School.

Mechanical Engineering (Ordinary Grade).

1st and silver medal, £2, J. R. Billington, Horwich Mechanics' Institute.
2nd and bronze medal, £2, H. Shoolbred, Heriot Watt College.
3rd and bronze medal, £1 10s., E. M. Hollingsworth, Manchester Technical School.
3rd and bronze medal, £1 10s., J. Fraser, Dundee Science School.

Mechanical Engineering (Honours Grade).

1st and silver medal, £3, G. Vardy, Newcastle Rutherford College.
2nd and bronze medal, £3, A. E. Collis, Lincoln Science School.
3rd and bronze medal, £2, I. H. Wright, Bradford Technical College.

Electro-Metallurgy (Ordinary Grade).

1st and silver medal, £2, F. J. Lowe, Birmingham Technical School.
2nd and bronze medal, £2, W. H. Riley, Birmingham Technical School.
3rd and bronze medal, S. Jones, Manchester Technical School.

Electro-Metallurgy (Honours Grade).

1st and silver medal, £3, S. Field, Birmingham Technical School.

Successes.

Locality.	Silver.	Bronze.	Total.
Accrington Mechanics' Institution	0	1	1
Barrow-in-Furness Board School	1	1	2
Bath Technical School	1	1	2
Belfast Technical School	1	8	9
Birmingham Jewellers' Technical School ...	1	4	5
Birmingham Technical School	6	3	9
Blackburn Technical School	0	1	1
Bolton Technical School	2	2	4
Bradford Technical College	3	5	8
Bridgwater Technical School	1	0	1
Bristol Technical College	0	1	1
Burnley Technical School	1	0	1
Burslem Wedgwood Institute...	0	2	2
Burton-on-Trent Institute	0	1	1
Camborne Science School	1	2	3
Cheltenham Technical School...	0	1	1
Cork	1	0	1
Coventry Technical Institute	0	2	2
Crewe Mechanics' Institute	1	0	1
Cromer Girls' School	0	1	1
Crosshills Glisburn Institute	1	0	1
Croydon County Polytechnic	2	0	2
Derby Technical College	0	1	1
Dundee Technical Institute	4	5	9
Dundee Science Schools	1	2	3
Eastleigh Railway Institute	1	2	3
Heriot Watt College	0	2	2
Galashiels Technical School	0	1	1
Glasgow Technical College	4	4	8
Halifax Technical School	0	1	1
Heanor Technical School	0	1	1
Helston Commercial School	0	1	1
Hinckley Grammar School	0	1	1
Norwich Mechanics' Institute...	1	0	1
Huddersfield Technical School	2	1	3
Hull Technical Schools	0	1	1
Hull Literary Institute...	1	0	1
Kettering Board School	1	1	2
Leed's Mechanics' Institute	2	1	3
Yorkshire College, Leeds	2	6	8
Yorkshire Ladies' Council	0	1	1
Nicholson Institute, Leek	0	1	1
Leicester Technical School	0	4	4
Leigh Technical School	0	1	1
Lincoln Science School	0	1	1
Liverpool School of Technology	1	2	3
Llanelly Higher Grade School	1	0	1
Battersea Polytechnic, London	1	1	2
Borough Polytechnic, London...	1	7	8
Finsbury Technical College, London ...	1	3	4
Goldsmith's Institute, London	1	3	4
Horological Institute, London...	1	1	2
Queen's Park Institute, London	0	1	1
Regent Street Polytechnic, London	5	8	13
St. Bride Institute, London	1	2	3
Stratford Mechanics' Institute, London ...	0	1	1
Telegraphists' School of Science, London ...	1	0	1
Westminster Technical Institute, London ...	0	1	1
Woolwich Polytechnic, London	1	0	1
London, Outside Students	5	5	10
Paget's Factory, Loughborough	1	1	2
Maidstone Science School	1	0	1
Manchester Technical School	11	14	25
Middlesborough High School	1	0	1
Middleton Technical School	0	1	1
Durham College of Science	0	2	2
Rutherford College, Newcastle	1	1	2
New Mills Board School	1	0	1
Northampton Technical Schools	0	2	2
University College, Nottingham	1	1	2
Oldham Technical School	1	0	1
Oxford Technical School	2	0	2
Peterborough School of Science	1	1	2
Portsmouth Technical Institute	1	0	1
Redruth Science School	1	1	2
Sheffield Central Schools	1	0	1
Shepshed British School	1	1	2
Shipley Technical Schools	0	2	2
Slough Technical School	0	1	1
South Norwood Polytechnic	0	1	1
Stalybridge Technical School	0	1	1
Stockport Technical School	0	1	1
Torquay School of Art...	0	1	1
Tunbridge Wells Technical Institute	0	2	2
Warrington Technical Institute	1	0	1
Wigan Mining School	0	1	1
Totals	88	145	233

SELF-PROPELLED ROAD VEHICLES.

The *Engineer* has offered its prizes of the value of 1,000 guineas for self-propelled road carriages, and is exerting itself to secure the amendment of the existing Acts relating to mechanical road vehicles. A correspondent of the same journal rather flouts the idea of the French gasolene carriages, and appears to lay stress rather on the necessity of heavier vehicles for freight service, and even capable of drawing other vehicles in addition to their own weight. We think this correspondent rather narrows the field, but he writes from Weston-super-Mare, and so may be ignorant of the conditions which obtain in Kent and Sussex, and of the need for some kind of machine that will move faster than a South-Eastern express. Our contemporary emphasises the word *oil* in distinction to *gasolene* as the fuel for certain road vehicles. We have already pointed out the dangers of the latter for city use, and pointed out that while the gasolene carriage may do in the country, it is hardly suitable for city work, if not by reason of danger, then by reason of smell, even if safe oil be the fuel employed. If the Weston correspondent be correct in his surmise as to goods traffic being of more importance than passenger, we see no reason why the electrically driven vehicle should not be largely employed. We doubt the practicableness of accumulator work on country roads; the accumulator vehicle will find its best field on the smooth pavements of the city; for the country, current can be picked up from a trolley wire with ease. The *Engineer* doubts if any electrically propelled vehicle will even be entered for the prize. This, of course, must largely depend upon the conditions of the competition, and the interpretation placed upon the words self-propelled. Is the vehicle to be entirely self-contained? then we doubt ourselves the practicableness of the electrical vehicle, but if the competition is to include moderately rapid heavy traction work, we see no just cause why a trolley line should not be included. Such lines need not by any means be exclusively given over to inter-communication between towns. They may well serve as feeder lines to railways. In discussing the question of feeder lines to main lines of railway, we have so far rather had in view such lines as would warrant the expense of rails, and of a properly ballasted track. But there are localities where this expense cannot perhaps at first be undertaken. This should not act as a deterrent. If the poles and wires alone can be put up, the ordinary roadway is good enough for vehicles to run upon, just as it is now good enough for the more ponderous traction engine. But the electrical traction engine has an advantage over the steam engine, in that there is no necessity for it to have a weight greater than what is necessary to haul its load. The steam traction engine is heavier than it need be on the mere score of tractive adhesion. In electrical work a motor vehicle with adhesion, brought up to the necessary amount by a load of turnips, will draw a train of other vehicles equally as well as if the tractive force was indebted to a steam boiler for adhesion.

Whatever be the outcome of the competition, we can only hope that the conditions may be as broad as possible, and commend the public spirit of the *Engineer* in taking up the subject in so liberal a manner. For rapidly moving vehicles the skill required in their guidance will, we fancy, be by no means contemptible, so very small an angle giving rapid lateral movement at a high speed, as anyone knows who has been accustomed to the tricycle.

THE REDCAR BOILER EXPLOSION.

The immediate effect of this lamentable piece of gross carlessness has been a recrudescence of the "Engineers *v.* Boiler Makers" question in respect of their suitableness as inspectors. We believe it to be a fact that there are more engineers engaged as inspectors than there are boiler makers, the plain facts of the case being that boiler making is not so often selected as an occupation by men of fitness as inspectors as is so-called engineering. There are therefore more fairly educated engineers open for the arduous duty of a boiler inspector than there are boiler makers. There is an

outcry on the part of some boiler makers as to this, but we venture to say that very little fault can be found with the choice of inspectors up to date. Mr. Longridge has shown how remarkably low is the percentage of explosions of inspected boilers and we very much question if this would be reduced by changing the inspectors. At the same time we must say emphatically that the competition between the various boiler insurance companies is not in the direction of safety. Boiler inspectors are notoriously an underpaid set of men, and they are frequently over-worked in a manner that would drive poor John Burns simply crazy. The rates now accepted for insuring boilers are insufficient to provide proper inspection, and though boiler inspection is considerably sought for by engineers, first, because they no not realise how poor the pay really is, and secondly, because the work is often looked upon as a stepping-stone to other work; we are of opinion that better service would be obtained from better paid men who would continue longer at the work. As it is, new men are continually being taught at an expense that would be better put into better salaries for longer service men. This cannot be done until it is recognised that the rates are too low or dividends are too high. But the Redcar explosion was not caused by lack of competent inspection, whether the inspector was an engineer or a boiler maker. It was caused by sheer neglect, to read the plain speaking of the Boiler Insurance Company, and we believe the works engineer has been made to suffer for this, for we note the appointment of another man to the post of engineer to the works. We suppose there had to be a scapegoat. It has never really transpired as to whether the engineer Allwood did or did not sufficiently impress on his employers the danger of the boilers, or whether his employers were of the snappish kind of ill-tempered people who lose control of themselves on being faced up with an expense such as renewing a lot of boilers. But we cannot exonerate them from blame in any case. We cannot doubt that they were aware of the risks they were taking, and they might at least have added some longitudinal stays if they were not prepared also to cut the boilers in two, seeing they were so very long and of so small a diameter.

THE COUNTER ELECTROMOTIVE FORCE IN THE ELECTRIC ARC.*

By W. H. FREEDMAN, E.E.

(*Concluded from page* 255.)

II. *Temperatures of the electrodes.*—The mean temperatures of the two electrodes are different and increase with the current. This can be easily proven by observing the appearance of the electrodes.

When the arc is blown out the positive electrode is brighter than the negative and takes much longer to cool, as can be tested by the colour. Furthermore, increasing the current, the portion of the electrode which is white and red hot, will become more and more.

Prof. Houston, on page 26 of his "Electrical Dictionary," under "Arc, Voltaic," says:

"S. P. Thompson has shown that the temperature of the light emitting surface of the carbon is the temperature of the volatilisation of carbon, and is therefore constant."

In article 233 of Advanced Grade of *Leaflets*, we also find: "The negative carbon is at a temperature sufficiently below that of the positive to permit the volatilised carbon to be condensed upon its surface in the shape of a small mound or nipple of graphite."

According to Rossetti, in a 10 ampère arc the positive carbon is 3,200° C., and the negative 2,500° C. (approximate).

Of course, the temperature of the negative carbon must depend on the quantity of heat developed by the impact of the carbon particles plus the heat absorbed from the intermediate vapour plus an almost negligible $C^2 R$.

This must vary with the current and with the length of the arc as the arc presents different radiating surfaces.

The larger the current and the shorter the arc, the higher should be the temperature of the negative electrode, and since the positive surface is constant, the difference of temperature between these two points will be less.

III. *Resistance of the arc.*—From an abstract in the London *Electrician* of December 29th, 1893, the conductivity of flames increases with the temperature. Therefore the resistance of the arc must decrease with the current due to raising the mean temperature. Increasing the current for a given distance between the electrodes has the effect of increasing the cross section of the arc and consequently further decreasing its resistance.

Conclusions.

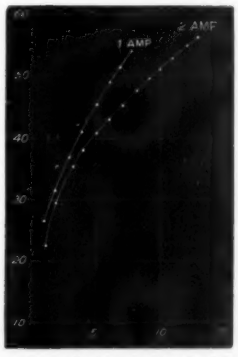
From these facts we can now conclude:

1st. There is a counter electromotive force present in an electric arc depending simply upon the material of the electrodes and the temperature of volatilisation of that material, and this counter electromotive force has a constant definite value for that material.

For as far as the vaporisation of the material of the electrode is concerned, this represents a certain amount of energy and must be supplied by the electrical energy of the circuit. Therefore, at this point in the circuit there must be a sudden fall of potential, such that this fall of potential multiplied by the current represents the energy necessary to vaporise the electrode.

Such a counter electromotive force must remain constant as long as the temperature of volatilisation of the electrode remains constant.

2nd. On account of the different temperatures there must be a thermo-electric effect. That is: there is a thermo-electric couple of the material of the electrode and of its vapour whose junction is at a much higher temperature than



Ordinates are volts. Abscissæ are hundredths of an inch.

Fig. 10.—Curves for Copper.

the rest of the circuit. The counter electromotive force due to this phenomenon must depend upon the difference of temperature between the electrodes. Consequently, it must increase with the length of the arc, as the temperature of the negative electrode falls; and it must decrease with the current, as the temperature of the negative electrode rises.

3rd. It is fair to assume that two ampères of current will tear off twice as many molecules, in the same length of time, from the positive electrode as one ampère; in strict analogy to electro-deposition. If the quantity of matter is doubled the resistance is most likely halved; so that $C R$ would remain a constant quantity. This would be so, provided the temperature remained constant. But since the temperature rises with increase of current and the resistance of flames decreases with increase of temperature, $C R$ must actually decrease with increase of current.

Now then we can explain the decrease of voltage with the increase of current for a given fixed distance.

By Ohm's law,

$$C = \frac{E}{R}.$$

The effective E.M.F. in our case is

$E = V - x - y$

V = difference of potential between the electrodes

x = constant counter E.M.F.

y = variable " "

* *Electric Power.*

Solving we get

$$V = x + y + C R.$$

Taking any fixed distance we see that V will decrease as the current increases since x remains constant and both y and C R decrease in value.

This then is the complete formula for the difference of potential between the electrodes ; in which,

x = the constant counter E.M.F., depending upon the material of the electrodes and its temperature of volatilisation.

y = the counter E.M.F. due to the thermo-electric effect being a function of the material of the electrodes and the difference of the temperatures ; the higher temperature being that of volatilisation of the electrode and the lower depending upon the material and size of the electrode, the current and the length of the arc.

C = the current strength.

R = the ohmic resistance of the arc depending upon the material of the electrodes, the length of the arc and the temperature on the current.

For any given material of electrodes analytically expressed in terms of length and current,

$$V = x + f(l, c) + c f'(l, c)$$

or in terms of temperature and currents,

$$V = x + f(t_2, t_1) + c f' t_2, t_1).$$

THE ELECTRIC LIGHTING OF THE CITY OF LONDONDERRY.*

The question of electricity supply, both for public and private lighting, is now becoming of so much importance to municipal engineers that when the author was asked to contribute something to this meeting of the Association, he thought he could not do better than give you a brief description of our generating station, with details of the scheme as adopted here for the public lighting of this city.

The idea of public lighting by electricity was first discussed by the Corporation so far back as March, 1888, but was allowed to drop.

The matter was again brought up two years later, and it was then agreed to take out a provisional order under the Electric Lighting Act of 1882.

In 1892 private companies made proposals to the Corporation, offering to lay down plant and run it under certain conditions. These proposals, however, the Corporation declined, and wisely determined to keep the monopoly of electrical supply under their own control.

As the time wore on, and the Board of Trade required the Corporation to take some active steps in the matter if they wished to retain their powers, they, in September, 1892, called in Mr. H. W. Blake as consulting engineer, to advise them on a scheme.

The following year the Corporation finally decided to adopt a scheme for the public lighting of the city by means of arc lamps. This scheme, prepared by Mr. Blake, was submitted to Dr. John Hopkinson, and on his approving of the specifications, &c., tenders for the plant were invited by advertisement, accepted, and gone on with as soon as the permission had been granted by the Local Government Board to borrow the necessary estimated capital of £15,000.

In the selection of a site for the station, the Corporation were particularly fortunate in obtaining on very favourable terms what had formerly been an old saw mill, situated in the Strand at a distance of some 700 yards from the centre of the city, having a frontage of 63 feet to that thoroughfare, and extending back 230 feet to the quay, and having an opening on to the river, thus affording every facility for storing our coal direct off the steamer, and also an ample supply of water for condensing purposes.

On this site in the central portion there has been erected a substantial brick building, comprising engine room and boiler house, temporary gables being erected at each end, so that if any extensions are contemplated, the buildings can be easily enlarged to accommodate the extra plant. The chimney stack, of handsome design, is octagonal in shape, 125 feet high and 5 feet in diameter, which is more than ample to suit any additional boilers that are ever likely to be required.

At present there are only two boilers laid down. They were supplied by Penman, of Glasgow, and are of the Lancashire type, 26 feet long and 7 feet in diameter, constructed for a working pressure of 125 lbs. per square inch. They are well provided with all the usual mountings, mostly of Hopkinson's latest type.

The feed water arrangements comprise two duplex double direct-acting pumps, each capable of supplying 900 gallons per hour against the maximum working pressure. The water is drawn from a storage tank of some 20,000 gallons capacity, placed on the roof of the boiler house, and supplied direct off the town mains. It can be delivered either direct or through the economiser, and all the steam and water pipes are in duplicate, in order to avoid as far as possible all risk of failure.

The economiser is one of Messrs. Green's, and consists of 96 4-inch tubes, 9 feet long. It is placed in the main flue, being heated by the waste gases from the furnaces. Suitable by-pass flues and dampers are provided to regulate the temperature of the feed water or shut off the economiser altogether for cleaning or repairs. To prevent the tubes from becoming covered with soot and thus reducing the efficiency of the apparatus, a small horizontal engine is provided, which, by means of suitable gearing, actuates a set of scrapers, which slowly traverse up and down the tubes, keeping their surfaces clean and free from soot. As we use nothing but Welsh steam coal, we have comparatively little soot, and the scraper engine, run for an hour or two at the beginning of each run, is sufficient to maintain the temperature of the feed water well up to 200° F.

The steam is conveyed to the engine room by two lines of 9-inch wrought-iron pipe, having 6-inch branch pipes to each boiler; both lines are common to each engine, and they are all thickly coated with a non-conducting composition to prevent loss from radiation. The pipes are provided with drain pipes and steam traps.

In the engine room are placed along one side three vertical compound condensing engines of 150 indicated horse-power, made by a local firm of engineers, Messrs. Brown & Sons. The diameters of the cylinders are, high pressure, 11 inches; low pressure, 22 inches; and the stroke 18 inches. The average speed at which they are run is 145 revolutions per minute. Each engine has a jet condenser of its own placed under the floor of the engine room, the air pump being operated off a crank disc on the end of the shaft. The condensing water is supplied to each engine by a separate 4-inch cast-iron pipe laid direct to the river, each pipe being fitted with a clack valve, rose head and mud box. A 9-inch cast-iron pipe serves as a common discharge to all the engines. An auxiliary injection pipe off the town mains is provided to each engine to assist at starting if the tide is very low or a suction pipe gets choked.

The speed of the engines is controlled by Hartnell's patent automatic expansion governor fitted on the crank shaft, which, by shifting the angle of advance of the high-pressure eccentric, varies the cut-off of the valve to suit the load. The distribution of steam is effected in the high-pressure cylinder by a piston valve, admitting the steam in the middle and exhausting at the outer edges, and in the low-pressure cylinder by an ordinary trick slide valve; by this arrangement the high-pressure piston gland is the only one which is subjected to the full working pressure.

All the bearings are of ample size, and are provided with a suitable means to take up the wear. The fly-wheels are 8 feet in diameter and 24 inches broad, and each weighs about 3 tons.

By means of two 10-inch leather belts, each engine drives two dynamos, placed on sliding rails, one behind the other. The dynamos are of the constant current series type, made by Messrs. Siemens Brothers & Co., Limited, London. They are designed for an output of 10 ampères at 3,000 volts at 750 revolutions per minute The machines have ring armatures rotating in a double magnetic field, and are fitted with copper commutators 18 inches diameter, divided into segments, and insulated with mica. We have had them running constantly for nearly 18 months at 2,500 volts, and often having them subjected to the most severe strains possible, and they have given no trouble whatever, the sparking is not excessive and the wear on the commutators very small. To keep the current constant a very ingenious regulator is provided, which automatically varies the voltage to suit the number of lamps on circuit by rocking the brushes back or forward; with these regulators in gear it is almost impossible to get more than 10 ampères for any time, and they give the current just as well on short circuit as when the whole resistance of the circuit is on. Last winter we had ample opportunity of testing them through the high winds which were so prevalent, putting lamps to work temporarily, and also when two faults would sometimes come on the cables at one time, cutting out 10 or 20 lamps.

From the dynamos the current is led to the switchboard by means of insulated cables laid in trenches under the engine room floor.

The switchboard, also made by Messrs. Siemens & Co., is composed of slate panels, in polished wood frames. It is arranged for six dynamos and four circuits, and is provided with short-circuit field switches, double-pole fuses, and a Swinburne electrostatic voltmeter to each dynamo; each circuit having a Siemens ammeter, double-pole fuses, and a Thomson-Houston lightning arrester on each end. By means of a plug-board any circuit can be run off any dynamo.

The lighting of the city is divided into two sections, each section having two circuits with lamps arranged alternately on different circuits. At present we have the lamps arranged on the four circuits as follows: 40, 43, 41 and 48, or 172 in all; but extra lamps will most probably soon be looped in to bring the numbers on each circuit up to over 50, and do away with some more of the gas lamps which still exist in some of the smaller streets.

The cables consist of $\frac{7}{18}$th copper strand heavily insulated with vulcanised India-rubber, served with a covering of bituminised jute, armoured with galvanised steel wires, the whole being covered with jute steeped in a preservative compound and laid in the ground direct. The armouring is earthed at every lamp, and also at the station ends. There are some 34 miles of this cable laid, the longest circuit being about 9 miles round, and the area lighted is, I think, one of the largest in the country. During the first six months after the plant was taken over by the Corporation we had a most unfortunate time of it, through failures of the lamp cut-outs, cables and other causes incidental to the start of such a large scheme. For a

* A paper read before the Incorporated Association of Municipal and County Engineers, at Londonderry, August, 1895, by John Christie, city electrical engineer.

long time this made the electric light most unpopular with many, but Messrs. Siemens successfully surmounted all the many difficulties as they cropped up, and in the very depth of winter entirely relaid the whole of the cables without interrupting the lighting of the city. All these failures are happily a thing of the past, and now we rarely have even a single lamp failure reported.

All the lamps are of the well-known Brockie-Pell double-carbon 32-hour type, so that in winter they only require trimming every second day, whilst in summer once a week suffices. Each lamp has fitted within itself a cut-out, which should the carbons burn out or the rods hang up from any cause, automatically cuts out the lamp from the circuit and forms a by-pass for the current to go on to the next lamp.

The lamps are fixed on ornamental cast-iron pillars 25 feet high, and pitched from 75 to 230 yards apart. In the base of each pillar, inside a locked door, an isolating switch is provided, by means of which any separate lamp may be extinguished, quite independently of any of the others on the same circuit.

A brief description of our method of detecting faults on the circuits may be of interest to some of you. Daily insulation resistance tests of all the circuits are taken, and if any one shows below the normal it is carefully watched; should it become dangerously low, the position of the fault is first roughly located by means of a Kelvin electrostatic voltmeter of the ordinary type, reading up to 6,000 volts; the weights on the vane are adjusted so that the scale reads 50 volts per division. One terminal of the instrument is then earthed, and the other terminal connected to the positive and negative ends of the faulty circuit, and two readings obtained, which, assuming the voltage per lamp at 50, reads directly the number of lamps from either end, about which the fault exists. By referring to the map we can at once go to almost the exact lamp, and by freeing the ends at the switch tell by means of a detector whether the fault lies in a lamp or a section of the cable between two lamps. This method I find saves an immense deal of trouble, rendering it unnecessary to split up a long circuit into several parts until the faulty one is found; and if the readings are carefully taken we can always spot the section within two lamps either way. If the fault proves to be in a lamp it is immediately remedied by replacing it with a spare one, and if in the cable and of low enough resistance, it is at the earliest opportunity burned out dead to earth by temporarily earthing one end of the line at the station, when by means of the loop test taken on the section with a portable testing set, the exact position of the fault is located and cut out. I am glad to say, however, that such faults never occur in the cable we now have through any inherent weakness of the insulation, but have always been clearly traceable to pick marks caused by some careless workman, when opening the street, accidentally striking the cable and neglecting to report it.

The cost of the whole scheme up to the present amounts to between £18,000 or £19,000. The difference between this amount and what was first estimated, is chiefly due to extensions of the scheme entered into after the contracts were settled.

The end of our financial year is not up till November, and the author regrets that he cannot now give you the exact cost of the public lighting. In winter during the long nights the works cost per lamp hour were as low as ·65d., and in summer when the runs were shortest they reached as high as 1·70d. per lamp hour. So far as can be judged, the total costs, including everything, should not much exceed £19 per lamp per annum, which, considering the number of hours we run (over 3,000), is by no means excessive.

No attempt has yet been made by the Corporation to introduce private lighting, except in the Guildhall and clock, which are both lighted by lamps looped off the street mains, but as they have every facility on the site of the present station for the accommodation and working of all the necessary plant for private lighting, and as the town is particularly well situated for the working up of a most lucrative electricity supply business, the author has no doubt that before long they will be following the example set them by nearly all other leading municipalities, and wisely keep the valuable monopoly of supplying electricity to the citizens in their own hands by extending their present station and laying down suitable machinery.

The author has nothing further to add, except to wish all of you a pleasant time during your stay in this part of the country, and bid you welcome to inspect our generating station this evening at 9 o'clock, when you will see the machinery at work which has been described to you in detail.

NEW PATENTS—1895.

15,529. "Improvements in electrical time switches." A. J. Wheatley. Dated August 19th.

15,547. "An improved method of operating electric locomotives, tramcars, and the like, and apparatus therefor." J. A Kingdon. Dated August 19th.

15,563. "Improvements in the formation of the electrodes for use in primary and secondary batteries." L. Epstein. Dated August 19th.

15,564. "An improvement in electro-propulsion of vehicles or vessels." L. Epstein. Dated August 19th.

15,664. "Improvements in electrical apparatus for railway signals actuated by passing trains." Siemens Bros. & Co., Ltd. (Communicated by Messrs. Siemens & Halske, Germany.) Dated August 20th.

15,686. "Improvements in electric railways." W. P. Thompson. (Communicated by J. F. McLaughlin, United States.) Dated August 20th. (*Complete.*)

15,695. "Improvements in electrically propelled carriages." E. J. Clubbe and A. W. Southey. Dated August 20th.

15,703. "Improvements in electric cables." G. G. M. Hardingham. (Communicated by the firm of Felten & Guilleaume, Germany.) Dated August 20th.

15,722. "Improvements in the formation of thin plates intended to be subsequently assembled as in certain electrical and like constructions." W. Thomson and W. Routledge. Dated August 21st.

15,736. "Improvements in insulating wire for electrical purposes." W. Patterson. Dated August 21st.

15,787. "An improved electric connecting device applicable to electroliers, electric light standards, brackets, and the like." R. W. Braham. Dated August 22nd.

15,794. "Improvements in incandescence filaments and other similar bodies for use in incandescence electric lamps." R. Walther. Dated August 22nd. (*Complete.*)

15,826. "Improvements in the insulation of electric cables." G. G. M. Hardingham. (Communicated by the firm of Felten and Guilleaume, Germany.) Dated August 22nd.

15,827. "An improved arrangement of apparatus for the generation of electricity on railway carriages or trains for lighting or other purposes." B. Rebikoff. Dated August 22nd.

15,863. "Improvements in dynamo-electric or electro-dynamic machines." J. G. Statter. Dated August 23rd.

15,868. "Improvements in arc lamps." J. D. F. Andrews. Dated August 23rd.

15,870. "Improvements in and relating to electrically controlled weighing apparatus." L. H. Nutting. Dated August 23rd. (*Complete.*)

15,880. "Improvements in electric accumulators." E. W. Jungner. Dated August 23rd.

15,886. "Improvements in or connected with electric batteries." C. J. Wollaston. Dated August 23rd. (*Complete.*)

15,889. "Improvements in the construction and working of electric arc lamps." La Societe les fils d'Adolphe Mougin. Dated August 23rd. [Date applied for under Patents, &c., Act, 1883, Section 103, February 11th, 1895, being date of application in France.]

15,895. "Improvements in electric contact making and breaking apparatus." S. Quincey and J. H. Collins. Dated August 23rd.

15,899. "Improvements in the construction of telephone instruments." T. F. J. Truss. Dated August 24th.

15,952. "Improvements in or appertaining to electric lighting apparatus." W. P. Thompson. (Communicated by W. Kaiser, Austria.) Dated August 24th.

15,969. "Improvements in incandescent lamps." P. Steins. Dated August 24th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1894.

20,807. "Improvements in telegraph transmitters." H. A. T. Taylor and J. A. L. Dearlove. Dated October 30th. Consists in arranging the instrument that each current sent into the line is immediately followed by another current of opposite sign and of shorter duration. 5 claims.

21,330. "Improvements in galvanic batteries." G. Hubner. Dated November 6th. Consists in employing the slimy liquid produced by treating wood cellulose with alkali and adding sulphuret of carbon, as described in complete specification No. 19,934, October 19th, 1894, but omitting the use of oxide of lead as therein described, for filling dry cell batteries having zinc and carbon electrodes. 3 claims.

24,613. "An improved electrical signalling system." W. P. Hall. Dated December 18th. Has for its main objects to simplify block signalling systems, and render more certain the operation of the signals, and also to provide means for indicating at a switch the approach of a train, in order that the switchman may keep the switch in proper condition for the passage of the train, the switch being preferably so connected with a signal in the rear, that a train approaching the switch will be blocked if the switch is not in proper condition for the train's passage. 18 claims.

1895.

1,544. "Improvements in and relating to electrical conductors." E. D. Lewis Dated January 22nd. One of the main objects is to insulate the line wire, thereby preventing injurious results which inevitably happen when a trolley wire, as usually provided, breaks and crosses telegraph and telephone wires, or falls to the street. 9 claims.

1,949. "A combined mat and electric alarum contact." J. J. Pye. Dated January 28th. Claim:—1. The combination with a mat of an electric alarum contact, consisting of a frame having spring contact pieces, and upon which a flexible metal plate rests, said contact pieces when the plate is depressed closing an electric circuit and ringing an alarum or bell in combination with a mat resting upon said plate, substantially as described and illustrated.

2,025. "Improvements relating to combined gas and electric light standards." R. W. BRAHAM. Dated January 29th. Claims:—1. For an electric light standard, a shade carrier having one or more of its arms made hollow or tubular to form a thoroughfare for gas, and a gas cock, or gas bracket, applied to the said carrier, substantially as and for the purpose specified. 2. The combination, with an electric light standard, of a shade carrier, having one or more of its arms hollow or tubular, and a gas cock or gas bracket mounted on the shade carrier, substantially as described.

2,031. "Improved automatic coupling for electromotors." SIEMENS BROS. & CO., LTD. (Communicated from abroad by Messrs. Siemens & Halske, of Berlin.) Dated January 29th. Consists in combining with the armature shaft a lever so arranged that when the shaft is shifted for engaging the coupling, the lever brings a soft iron armature connected thereto against the field magnet poles or against the poles of a separate electro-magnet included in the circuit, which magnet consequently holds the lever and clutch in the engaged position so long as current is passing, notwithstanding any fluctuation that may occur in the strength of the magnets. 1 claim.

2,333. Improvements in apparatus for the use of the electric light for photographic purposes." A. G. ADAMSON. Dated February 2nd. Relates to a further development of patents Nos. 21,379, 1893, and 5,971, 1894. 1 claim.

2,913. "An improved method of and apparatus for controlling electromotors." J. DEVONSHIRE. (A communication to E. D. Priest, of America.) Dated February 9th. The apparatus consists of two cylinders, one of which, the commutating or controlling cylinder for the motors, is adapted to revolve continuously in either direction, while the other, which is used as a switching cylinder for the resistances in ways well understood, does not revolve, but reciprocates about its axis; the two cylinders are geared together, and the relation of the gearing is such that the reciprocating cylinder makes a complete stroke, that is, from one side to the other, or from a position where all of the resistance is in circuit to one in which it is cut out and back again, during a partial revolution of the commutating cylinder; and by a slightly greater movement of the commutating cylinder, the circuit is opened upon the resistance switching cylinder, or the resistance cylinder. 9 claims.

2,916. "Improvements in systems of electric distribution." J. DEVONSHIRE. (A communication from abroad by C. P. Steinmetz, of America.) Dated February 9th. This invention relates to a system of electrical distribution for multiphase currents, by which currents 60° apart in phase may be converted into currents 120° apart in phase, or the reverse. The conversion of one system into the other is effected by two transformers, in which the primary and secondary windings occupy relatively a reversed relation, so that in a 60° system the phase of one of the currents will be changed through an angle of 180°, thus occupying a phasal relation with reference to the other two currents, such that all three are 120° apart. 7 claims.

2,917. "Improvements in systems of electrical distribution." J. DEVONSHIRE. (A communication from abroad by C. P. Steinmetz, of America.) Dated February 9th. Consists in an arrangement whereby motors of the three-phase type may be operated from line circuits in which flow currents 60° apart in phase, with only a slight change in the construction of the motors from that of ordinary well-known machines of this class. This change consists in reversing one of the three coils of the motor, so that the current flows through this reversed coil in an opposite direction from that in the ordinary motor, and thereby produces the same effects, so far as the operation of the motor is concerned, as has been heretofore secured by currents differing in phase by 120°. 4 claims.

2,918. "Improvements in dynamo electric machines." J. DEVONSHIRE. (A communication from abroad by C. P. Steinmetz, of America.) Dated February 9th. Consists in arranging the coils in separate sets of sections, whose combined effect is the same as that of the continuously overlapping coils now used, but whose end portions or cross connections, while overlapping in each set, do not overlap those of other sets. 9 claims.

3,062. "Improvements in electric locomotives." E. M. BOYNTON. Dated February 12th. Consists in placing the motor within the wheel, thus reducing the weight of the motor to the very lowest limits, and at the same time, by having armature and field magnets inclosed in the wheel, make the motor more independent of outside influences, as water, snow, dust, &c. 8 claims.

3,085. "Improvements in and relating to electric gas-lighting devices." J. JAHNSSON. Dated February 12th. The object of the present invention is an electric gas-lighter, which will be positive in its action, will require no special adjustment, and owing to its simplicity, will not get out of order. 1 claim.

3,086. "Improvements in telegraphic apparatus." H. H. LAKE. (Communicated from abroad by World Flash Company, of Chicago.) Dated February 12th. Relates to transmitters used for electric telegraphy, and is more especially directed to the improvement in structure of such machines wherein conventional signals distinct for each letter or character of the code (*e.g.* according to the Morse system) are automatically sent in regular succession to form the message by the selective working of the individual finger-keys in the bank or keyboard appropriate thereto. 4 claims.

3,134. "Improvements in apparatus for indicating or recording telephonic connections. F. W. H. HEMPEL and A. MAERKER. Dated February 13th. The object of the present invention is to provide an arrangement by means of which control or indication of use of the telephone by subscribers is obtained so far as the subscriber is concerned, whilst the use of it on the part of the summoned subscriber is not controlled. 2 claims.

3,779. "Improvements in economising apparatus for the carbons of electric arc lamps." A. ALBRECHT. Dated February 21st. Consists essentially of a hollow receptacle comprising two parts, which enclose the points of the upper and lower carbon pencils, and which are connected together. The thus connected parts are suspended in an appropriate manner on wire-arms—preferably made of platinum—from the point of the bottom carbon, and follow its movement as it burns down. 5 claims.

4,106. "Dynamo-electric generators and motors." A. E. LONES. Dated February 26th. An electric motor, or a dynamo-electric generator, is constructed so that any part may be quickly and easily removed for examination, replacement, or repairs. Nearly the whole of the wire of the armature coils is also rendered effective in generating or utilising the current. 3 claims.

4,153. "Method of and apparatus for insulating electrical conductors." J. Y. JOHNSON. (Communicated from abroad by L. W. Downes, of Rhode Island.) Dated February 26th. The wire after being first coated with a quick drying adhesive material, such, for example, as gum, is covered with asbestos fibre, wound spirally or otherwise thereon by any suitable mechanism well known to those familiar with the art. The wire is then subjected to a finishing process, consisting in carding or brushing the asbestos covering to remove all superfluous lumps and irregularities, and laying the nap all in one direction, then applying pressure to the covering, whereby the fibre is matted together in a compact layer, the thickness being gradually reduced to the required extent, and then applying a coating of waterproofing and toughening material to protect the insulation from injury in handling, and to impart to it moisture resisting properties. After these operations the conductor is preferably passed between pressure rolls, and drawn through dies to impart a smooth finish, and reduce the insulated conductor to an even diameter. 5 claims.

4,160. "Improvements in electric transformers or converters." H. H. LAKE. (Communicated from abroad by Thomson Electric Welding Company, of America.) Dated February 26th. Consists in making the secondary or heavy section element of the apparatus as a liquid tight tube which envelops the primary, and in keeping the primary immersed in oil contained in said secondary. Consists, further, of an electric transformer having a primary wound with a number of turns, and a secondary having but one turn, and composed of a single tube which follows the winding of the primary coil and forms a tubular envelope or jacket therefor throughout substantially its whole length. Consists, further, in making the secondary or heavy section element from two solid copper castings bolted together to form a tube enclosing the primary. 12 claims.

4,245. "Improvements in electrical galvanic batteries." G. LAURA. Dated February 27th. Has for its object, therefore, a novel method of construction of the elements of a sulphate of copper battery, characterised more particularly by the use between the copper and the zinc, of a special diaphragm; and by the combination in the element of such battery—with the special diaphragm—of a suitable receiver, serving as a store for the sulphate of copper. 3 claims.

4,458. "Improvements in or relating to apparatus for electrically steering ships." F. A. LANGEN. Dated March 2nd. Depends for its working on the closing and interruption of different electric circuits by means of a steering dial switch device. 9 claims.

4,551. "Electrical cut-outs." E. A. CLAREMONT. Dated March 4th. Claim:—A fuse wire of an electrical cut-out in such close proximity to a resistance, that the heat arising from the latter will tend to melt it.

4,557. "Conduit electric railway." L. C. PRESSLEY. Dated March 4th. Relates to improvements in electric railways, in which a current is carried beneath the surface of the ground, and is transmitted at intervals to the rail or conductor through which it in turn passes to the car and the motor thereon. 4 claims.

4,939. "A new process of electrolysis, and apparatus therefor." E. ANDREOLI. Dated March 8th. The anode and cathode, to which the electric generator is connected, are situated in compartments of a vessel, the said compartments being formed by two porous partitions, and the said compartments containing suitable electrolytes. The solution to be treated by the indirect electrolysis is contained in or passed through a compartment, situated between the anode and cathode compartments. 2 claims.

5,099. "An improved electric gas lighter. F. M. KASS. Dated March 11th. Claim:—An electric gas lighter, having a movable toothed sector or its equivalent for one terminal, and a brush for the other terminal, the sector being operated from a catch, and its teeth caused to pass over the brush, so as to produce a succession of sparks, substantially as set forth with reference to the dawings.

5,196. "Improvements in thermo-electric generators." H. B. COX. Dated March 12th. The object of the invention is to provide a practical, economical and commercially successful thermo-electric generator. 11 claims.

5,500. "Improvement in incandescent electric lamps." A. LUCCHESINI. Dated March 15th. Claim:—The employment in the interior of incandescent lamps of a flat mirror which reflects the light from the incandescent filament, with the object of increasing the illuminating power of such lamps, the mirror being fixed in position either by the means described and shown in the drawing, or by any other equivalent means, substantially as specified.

5,742. "Apparatus for automatically limiting the speed of electric cars." L. S. WRIGHT. Dated March 19th. The primary object of the invention is to afford means whereby when the running speed of an electric car attains a predetermined limit, the brakes shall be applied, and the current simultaneously cut off or diminished, so as to arrest or slow down the movement of the car, and require the attention of the motorman to re-establish the normal running. 2 claims.